

THE UTILISATION OF WATER POWER
IN SCOTLAND
1550 - 1870

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ABSTRACT

"The Utilization of Water Power in Scotland 1550 - 1870"

The use of water power in grain milling, and its contribution to the early stages of the Industrial Revolution, particularly in textile manufacture and iron-working, are widely acknowledged. However, a view of the Industrial Revolution as a relatively late, primarily urban phenomenon, has tended to overshadow the importance of water power. It is the author's contention, in this writing, that the importance of water power, as a source of energy, has been underestimated.

I declare that the research undertaken and the composition of this Thesis is entirely my own work.

In Scotland, where the case for revision might be expected to be even stronger, little work has been carried out beyond local or individual studies. The present study is a general history of the Scottish water power industry, from 1550 to 1870, with particular reference to the century 1750 - 1850, when the importance of water power was at its height. It is an exploratory work of this nature, covering as broad a range of subjects as possible, and the space available does not permit of a more detailed treatment of any one aspect. However, the author's interest in the utilization of water power in industry, and in the development of the water power industry, has led to a more detailed study of the water power industry in Scotland, and in particular to a study of the water power industry in the Scottish Highlands. The pattern of the water power industry in Scotland, and the role of the water power industry in the Scottish economy, are the main subjects of this study.

ABSTRACT

"The Utilisation of Water Power in Scotland 1550 - 1870"

The use of water power in grain milling, and its contribution to the early stages of the Industrial Revolution, particularly in textile manufacture and iron-working, are widely acknowledged. However, a view of the Industrial Revolution as a relatively late, primarily urban phenomenon, has tended to over-stress the importance of steam power while minimising, or even writing off, that of water power. Musson, among others, has emphasised the need to redress the balance, but has had to base his case on mostly English data. In Scotland, where the case for revision might be expected to be even stronger, little work has been carried out beyond local or thematic studies by Jespersen, Turner, Butt, Hume and Donnachie.

The aim of the thesis is to establish a spatial, chronological and numerical development of the water mill in Scotland and to relate this to innovations in technology, impact on the landscape, the rise of steam power and the overall evolution of the Scottish economy. The chosen period of study extends from 1550 to 1870; particular attention is given to the century 1730 - 1830, when the use of water power was at its height.

In an exploratory work of this nature, covering so broad a subject over so long a period, the space available does not allow each application to be covered in great depth. Nevertheless, by examining the utilisation of water power industry by industry, it can be determined how many mills of each type were being used where, when and by whom. The pattern

which emerges confirms, and emphasises further, the crucial role of water power in grain processing industries and in wool, linen and cotton textile manufacture, besides indicating just how much the early stages of the Industrial Revolution owed to the utilisation of water power. Furthermore, it lends support to the view that, in Scotland, water power was of greater significance vis-a-vis steam power, for longer and in a wider range of industries than some earlier interpretations of power in the Industrial Revolution, based largely on English evidence, would suggest.

INDEX

<u>Chapter</u>	<u>Title</u>	<u>Page</u>
I	The Technology of Water Power 1550-1730	1
II	Grain Mills	16
III	Water Power in the Textile Industry	51
IV	Paper Mills	68
V	Coal Mining	81
VI	The Mining and Manufacture of Non-Ferrous Metals	94
VII	Water Power in the Iron Industry	110
VIII	Sawmills	123
IX	The Technology of Water Power 1730-1830	135
X	The Rural Corn Mill	150
XI	Flour and Pot Barley Mills	177
XII	Urban Grain Mills	187
XIII	Brewing and Distilling	202
XIV	The Mill on the Farm	211
XV	Lint Mills	235
XVI	Bleachfields	299
XVII	Flax Spinning Mills	355
XVIII	Woollen Mills 1730-1785	378
XIX	Woollen Mills 1785-1830	401
XX	Cotton Mills	461
XXI	The Textile Industry : Minor Users of Water Power	495
XXII	Paper Mills	515
XXIII	Coal Mining	542
XXIV	Mining and Metallurgy : Non-Ferrous Metals	566
XXV	The Iron Industry	601
XXVI	Saw Mills 1730-1830	647

Chapter

Title

Page

XXVII	Minor Users of Water Power	687
XXVIII	Water Management Schemes	716
XXIX	Water Power in the Age of Steam 1830-1870	732
XXX	Conclusion	781
APPENDICES		794
BIBLIOGRAPHY		842

ABBREVIATIONS USED

<u>AAC</u>	Ayrshire Collections/Ayrshire Archaeological Collections
<u>AHS</u>	Abertay Historical Society
<u>APS</u>	Acts of the Parliament of Scotland
<u>BOEC</u>	Book of the Old Edinburgh Club
<u>EcHR</u>	Economic History Review
<u>IA</u>	Industrial Archaeology
<u>IRA</u>	Inquisitionum ad Capellam Domini Regis Retornatum Abreviato
<u>NLS</u>	National Library of Scotland
<u>NSA</u>	New Statistical Account
<u>OS</u>	Ordnance Survey
<u>OSA</u>	(Old) Statistical Account
<u>OSP</u>	Old Court of Session Papers, Signet Library
<u>PP</u>	Parliamentary Papers
<u>RCAHMB</u>	Royal Commission on Ancient & Historic Monuments and Buildings
<u>RMSRS</u>	Registrum Magni Sigilli Regnum Scotorum (Register of the Great Seal)
<u>RSSRS</u>	Registrum Secreti Sigilli Regnum Scotorum (Register of the Privy Seal)
<u>SBRS</u>	Scottish Burgh Record Society
<u>SGM</u>	Scottish Geographic Magazine
<u>SHS</u>	Scottish History Society Publications
<u>SHR</u>	Scottish Historical Review
<u>SRO</u>	Scottish Record Office
<u>SRS</u>	Scottish Record Society
<u>SSIA</u>	Scottish Society for Industrial Archaeology
<u>SPAB</u>	Society for the Protection of Ancient Buildings

<u>TELA&FNS</u>	Transactions of the East Lothian Antiquarian & Field Naturalist Society
<u>TGAS</u>	Transactions of the Glasgow Archaeological Society
<u>THAS</u>	Transactions of the Hawick Archaeological Society
<u>TH&AS</u>	Transactions/Prize Essays of the Highland and Agricultural Society
<u>TIBG</u>	Transactions of the Institute of British Geographers
<u>TNS</u>	Transactions of the Newcomen Society

ILLUSTRATIONS

Sources, other than original research, are given in brackets; where prefixed by "from", illustrations have been compiled from information in text, tables or maps.

<u>Figure Number</u>		<u>Following Page No..</u>
1.1	Machinery of horizontal (Shetland) mill (Re-drawn from Goudie, <u>PSAS</u> XX (1885-6))	1
1.2	Distribution of horizontal mills in Lewis (From <u>O.S.</u> 6"/mile 1st edition (1849-53))	1
1.3	Distribution of horizontal mills in Shetland (From <u>O.S.</u> 6"/mile 1st edition (1878))	1
1.4	Distribution of place names in "mhuilinn", N.W. Highlands (From <u>O.S.</u> 6"/mile 1st edition (1856-78))	3
1.5	Horizontal mill at Dounby, Orkney (<u>HMSO</u> photograph)	4
1.6	Types of vertical water wheel	6
1.7	Distribution of tide mills	8
1.8	Ayre Mills, Kirkwall, Orkney (<u>Orcadian</u> photograph)	4
2.1	Corn mill machinery, 17th - 18th century	16
2.2	Duration of mill tacks, 1550 - 1729	30
2.3	Percentage of commuted mill rents, 1550 - 1729	30
2.4	Glasgow Burgh and Baxter Mills, 1550 - 1729	34
2.5	Rate of Glasgow Burgh Mill tacks, 1626 - 1730 (From <u>SBRS</u> Glasgow I - V)	38
3.1	Machinery of 16th century (Italian) fulling mill (Reynolds, <u>Windmills & Watermills</u>)	152
3.2	Distribution of fulling mills, 1550 - 1730	53
4.1	Machinery of 17th century (Italian) paper mill (Waterston, <u>BOEC</u> XXV (1945))	68
4.2	Distribution of paper mills, 1550 - 1730	78
5.1	16th century (German) mine pump (Agricola, <u>De Re Metallica</u>)	82
5.2	Clackmannan coalworks, 1713 (<u>SRO</u> RHP 3847)	84
5.3	Distribution of water engines on Scottish coal mines, 1550 - 1730	86
5.4	Water engines, dams and lades in S.W. Fife	87

Figure
Number

Following
Page No.:

6.1	16th century (German) ore stamping mill (Agricola, <u>De Re Metallica</u>)	94
6.2	16th century (German) smelting mill (Agricola, <u>De Re Metallica</u>)	94
6.3	Distribution of lead and silver mills, 1550 - 1730	106
7.1	16th century (German) smelting mill (Agricola, <u>De Re Metallica</u>)	110
7.2	16th century (German) trip hammer (Agricola, <u>De Re Metallica</u>)	110
7.3	Distribution of iron mills, 1550 - 1730	110
8.1	Machinery of mid-18th century frame-saw mill (Redrawn from <u>SRO GD44/10/19/17</u>)	123
8.2	Distribution of sawmills, 1550 - 1730	125
9.1	Smeaton's model for testing the power of undershot water wheels (Smeaton, <u>Reports</u>)	140
9.2	Examples of cycloidal gearing	141
9.3/4	Smeaton's water wheel for Carron boring mill (Smeaton, <u>Reports</u>)	143
9.5	Suspension wheel at Catrine Mills (Wilson, <u>Water Power & the Industrial Revolution</u>)	143
10.1	Machinery and layout of improved corn mill (Low, <u>Report on Marchmont Estate</u>)	151
10.2	Thirlage rates, 1790's (<u>OSA</u>)	159
10.3	State of thirlage, 1790's (<u>OSA</u>)	163
10.4	Conversion of corn mills to other uses	170
11.1	Millstone for flour (Reynolds, <u>Windmills and Watermills</u>)	177
11.2	Machinery and layout of double flour mill, circa 1810 (Jamieson, <u>Dictionary of Mechanical Science</u>)	179
11.3	Distribution of mills with pease ovens	184
12.1	The Burgh Mills of Perth	188
12.2	Distribution of steam powered grain mills to 1830	198
14.1	Patent drawing of Meikle threshing machine (Cartwright, <u>TELA&FNS XI 1968</u>)	216

<u>Figure Number</u>		<u>Following Page Number</u>
14.2	Farm Buildings incorporating water-powered threshing mill, Skelbo, Sutherland (Loch, <u>Improvements on the Stafford Estates</u>)	219
14.3	Barley hummelling machine (Henderson, <u>General View of Sutherland</u>)	224
14.4	Blairdrummond water-raising wheel (Sinclair, <u>General Report</u>)	228
14.5	Reduced plan of Blairdrummond Moss	228
15.1	Ground and first floor plans, Invervar lint mill	239
15.2	Lint mill machinery and layout (Jamieson, <u>Dictionary of Mechanical Science</u>)	239
15.3	Board of Trustees grants for lint mill sheds, 1760-1824 (From <u>Minutes of Board of Trustees</u>)	243
15.4	Cumulative number of lint mills built, 1729-1829	254
15.5	Lint mills built with Board of Trustees aid (From <u>Minutes of Board of Trustees</u>)	256
15.6	Lint mills repaired with Board of Trustees aid (From <u>Minutes of Board of Trustees</u>)	256
15.7	Distribution of lint mills first recorded 1729-44	256
15.8	Distribution of lint mills first recorded 1745-59	262
15.9	Distribution of lint mills first recorded 1760-72	262
15.10	Distribution of lint mills, 1772 Survey (From <u>SRO NG1/19/1</u>)	263
15.11	Distribution of lint mills first recorded 1772-89	264
15.12	Distribution of lint mills first recorded 1790-99	264
15.13	Distribution of lint mills first recorded 1800-14	265
15.14	Distribution of lint mills first recorded 1815-30	266
15.15	Distribution of lint mills, 1729-1830	267
15.16	Plan showing site of Grangehaugh lint mill (Per Mr. E. Jeffrey, Biel Grange)	268
15.17	Grangehaugh lint mill 1979	268
15.18	Lands rented by Thomas Finlayson for flax cultivation (From <u>SRO GD6/1275</u>)	270
15.19	Origin of flax dressed at Grangehaugh lint mill, 1751-2	270
15.20	Machinery of oil mill (Jamieson, <u>Dictionary of Mechanical Science</u>)	280
15.21	Distribution of oil mills, 1730-1830	281

<u>Figure Number</u>		<u>Following Page No.</u>
16.1	Bleaching house at Deskford Bleachfield, circa 1752 (SRO GD 248/951/5)	299
16.2	19th Century (Irish) beetling machine (McCutcheon, TNS XXXIX, 1966-7)	303
16.3	Destinations of Saltoun apprentices (SRO NG1/1/20-29)	312
16.4	Distribution of water-powered bleachfields 1730-1830	319
16.5	Saltoun Bleachfield c.1760	337
16.6	Distribution of plash mills 1730-1830	345
17.1	Kendrew and Porthouse flax spinning frame (Singer et al, <u>History of Technology</u> IV)	355
17.2	Water and steampower in Scottish flax spinning mills 1838 (PP 1839 XLII)	358
17.3	Distribution of water-powered flax spinning mills	359
18.1	19th century fulling mill machinery	379
18.2	Distribution of waulk mills, 1730-1785	388
19.1	Galashiels woollen mills	415
19.2	Distribution of water-powered woollen mills 1730-1830	425
19.3	The Hillfoots District	436
19.4	The Archibald Family Tree (From Gibson, <u>Reminiscences of Dollar</u> etc.)	438
19.5	Machinery in Hillfoots Woollen Mills, 1819 (SRO NG1/60/54/1)	444
20.1	Old Mill, Johnstone, c.1790	462
20.2	Distribution of water-powered cotton mills founded 1778-89	476
20.3	Distribution of water-powered cotton mills founded 1790-1799	477
20.4	Distribution of water-powered cotton mills founded 1800-1830	478
20.5	Distribution of water-powered cotton mills 1778-1830	479
20.6	Water-powered cotton mills in the Cart Basin	482
20.7	Cotton mill communities in the Cart Basin	486
21.1	Distribution of water-powered printfields 1730-1830	500
21.2	Printfields on the Dumbartonshire Leven	501

<u>Figure Number</u>		<u>Following Page No.</u>
21.3	Printfields in the Perth Area	502
21.4	Distribution of Dyewood Mills, 1730-1830	508
21.5	Distribution of thread twisting and beating mills	510
22.1	Hollander (Waterston, <u>BOEC XXVII 1949</u>)	515
22.2	Paper Machine (Thomson, <u>Paper Industry in Scotland</u>)	516
22.3	Vats and paper machines in water-powered paper mills, 1832 (From <u>Paper Mills in Scotland, 1832</u>)	516
22.4	Distribution of paper mills 1730-1749	524
22.5	Distribution of paper mills established 1750-1779	525
22.6	Distribution of paper mills established 1780-1799	526
22.7	Distribution of water-powered paper mills founded 1800-1830	527
22.8	Distribution of water-powered paper mills founded 1730-1830	527
22.9	Paper mills on the Midlothian Esk 1730-1830	531
23.1	Water engine at Strathore, Fife (Duckham, <u>Scottish Coal Industry</u>)	543
23.2	Distribution of coal water engines and gins	552
24.1	Water Pressure Engine (Jamieson, <u>Dictionary of Mechanical Science</u>)	569
24.2	Water wheel and trompe. (<u>SRO GD18/5955</u>)	571
24.3	19th century ore crushing mill (Phillips & Darlington, <u>Records of Mining and Metallurgy</u>)	572
24.4	19th Century buddle, sieves and cistern (Phillips & Darlington, <u>Records of Mining and Metallurgy</u>)	572
24.5	Scotch Hearth	574
24.6	Lead Smelter and trompe (<u>SRO GD 18/5955</u>)	574
24.7	Leadsmelter plan and elevation (From Donnachie, <u>Industrial Archaeology of Galloway</u>)	574
24.8	Strontian, c.1730 (Murray, <u>The Interest of Great Britain</u>)	581
24.9	Distribution of water-power in non-ferrous metallurgy and mining	587
25.1	Bonawe iron smelter (<u>RCAHMB Lorn</u>)	602

<u>Figure Number</u>		<u>Following Page No.</u>
25.2	Blowing Engine for Carron furnace No. 1 (Smeaton, <u>Reports</u>)	603
25.3	Distribution of blacking mills 1730-1830	604
25.4	Boring mill for Carron Ironworks (Smeaton, <u>Reports</u>)	605
25.5	Distribution of Water-power in the ironworking industry 1730-1830	622
26.1	Machinery of mid-18th century frame sawmill (Redrawn from <u>SRO GD44/10/19/17</u>)	647
26.2	Machinery of early 19th century circular sawmill (Montheith, <u>Forester's Guide</u>)	649
26.3	Horizontal boring mill (Rolt, <u>Tools for the Job</u>)	649
26.4	Sawmill on Molendinar Burn, Glasgow c.1760 (<u>SBRs Glasgow VI</u>)	657
26.5	Distribution of water-powered sawmills 1730-1845	669
27.1	Distribution of Snuff, bark shammy and powder mills 1730-1830	690
27.2	List of water-powered bark mills	696
27.3	Improved flint mill (Clow & Clow, <u>Chemical Revolution</u> ; Singer <u>et al</u> : <u>History of Technology</u>)	699
27.4	Distribution of water-powered flint mills 1730-1830	703
28.1	Plan of Shaws Water Aquaduct, Greenock (<u>NSA VII Renfrewshire</u>)	721
28.2	Shaws Water Aquaduct. Occupants of Falls, 1845 (From: Hutcheson's <u>Greenock Register, 1845</u>)	722
28.3	Water regulating reservoirs in East Renfrewshire	724
28.4	Water mills on the Fife Leven, 1830	726
29.1	Outward axial and inward flow turbines (Fairbairn, <u>Mills and Millwork</u>)	734
29.2	Whitelaw's "Scotch" turbine (Fairbairn, <u>Mills and Millwork</u>)	735
29.3	Survey dates, 1st edition Ordnance Survey of Scotland.	739
29.4	Foundation dates, Scottish Distilleries 1770-1870 (From Barnard, <u>Whisky Distilleries</u>)	742
29.5	Distribution of water-powered distilleries c.1886 (From Barnard, <u>Whisky Distilleries</u>)	742
29.6	Distribution of water-powered sawmills c.1846-80 (From <u>OS 1st Edition 6"/mile</u>)	746
29.7	Distribution of water-powered wood-turning mills c.1846-1880 (From <u>OS 1st Edition 6"/mile</u>)	747

<u>Figure Number</u>		<u>Following Page No.</u>
29.8	Distribution of bone and farina mills c.1846-1880 (From <u>OS</u> 1st Edition 6"/mile)	748
29.9	Distribution of water-powered paper mills 1830-1870 (From Thomson, <u>Paper Industry in Scotland</u>)	754
29.10)	Water-power, steam-power and power looms in	758
29.11)	woollen mills 1838-1871 (From Factory Returns, <u>PP</u> 1839 XLII; 1850 XLII; 1867-8 LXIV; 1872 XXXIV)	
29.12	Water and Steam power in woollen mills, 1838, 1850, 1867, 1871. (Source as for 29.10 & 11)	759
29.13	Distribution of water-powered woollen mills c.1846-80	761
29.14	Distribution of water-powered lint mills c.1846-80 (From <u>OS</u> 1st edition 6"/mile)	761
29.15	Water and steam power in flax-spinning mills 1838, 1850, 1867, 1871. (Source as for 29.10 & 11)	766
29.16	Water-power, steam-power and power looms in flax- spinning mills 1838-1871 (Source as for 29.10 & 11)	767
29.17	Distribution of water-powered flax-spinning mills c.1846-1880 (<u>OS</u> 1st Edition 6"/mile)	767
29.18	Bleachworks and beetling mills in the Perth area c.1860 (From <u>OS</u> 1st edition 6"/ mile)	768
29.19	Water-power, steam-power and power looms in cotton spinning mills 1838-1871 (Source as for 29.10 & 11)	770
29.20	Water-power and steam-power in cotton-spinning mills 1838, 1850, 1867, 1871 (Source as for 29.10 & 11)	771
29.21	Water and steam-power in printworks and bleaching and dyeing works 1870 (Factory Returns <u>PP</u> 1872 XXXIV)	772
29.22	Distribution of water-powered cotton mills c.1846- 80 (<u>OS</u> 1st edition 6"/mile)	772
29.23	Distribution of water-powered mining and metal- working sites c.1846-80 (<u>OS</u> 1st edition 6"/mile)	774

1550 - 1730

1550 - 1730

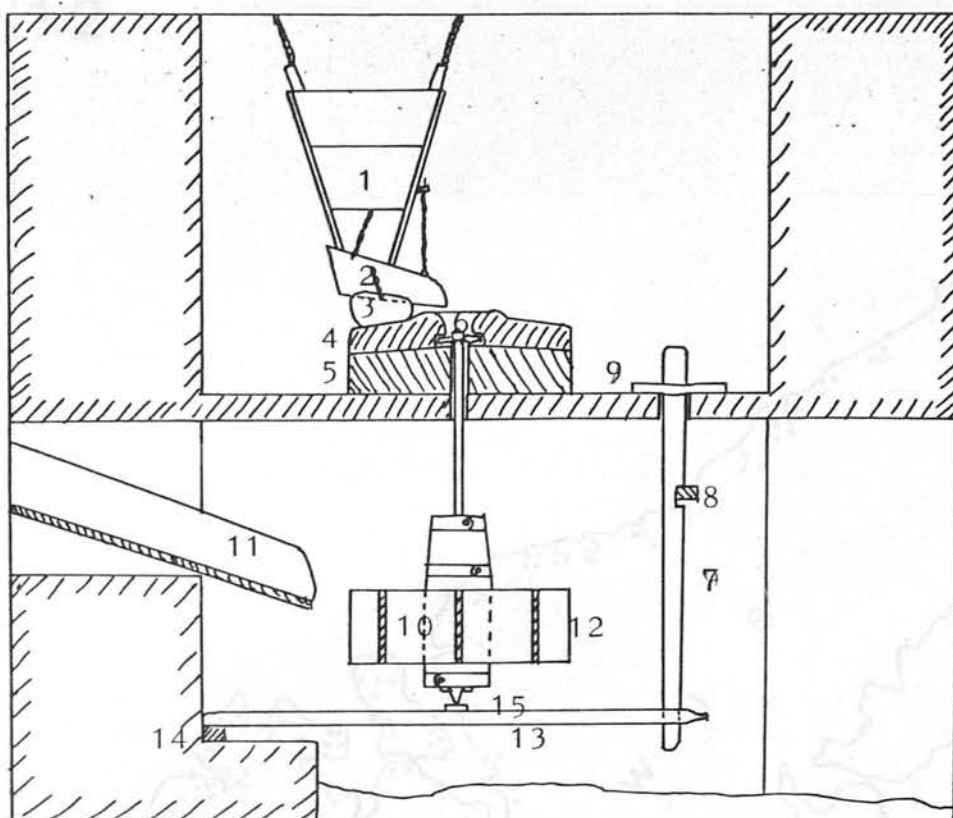
CHAPTER ONE

THE TECHNOLOGY OF WATER POWER 1550 - 1730

Before considering the processes to which the power of water was applied something should be said of the means whereby it was harnessed, for an understanding of this not only puts contemporary mills into perspective, but also relates^{to} the developments in the following century when water power was to become the driving force behind the Scottish Industrial Revolution. The first point to be considered concerns the dichotomy between horizontal and vertical types of mill, both of which occurred in Scotland.

Horizontal Mills

Since Classical times, two types of water-mill, the vertical and horizontal, have been in use in Europe. The latter is driven by a very simple type of water-wheel, set horizontally on the same vertical shaft as the stones themselves (figure 1.1); such an arrangement obviates the need for gearing. The earliest reference to a horizontal mill is to one operating in Asia Minor early in the 1st century B.C.; at later periods many others are found, notably in the more isolated parts of Europe such as The Alps, Romania, Norway and Scotland. As late as the 19th century such mills survived in great numbers in the Northern and Western Isles of Scotland: about 150 appear on the first Ordnance Survey maps of Lewis, c.1850 (figure 1.2) and about 500 on those of Shetland c.1878 (figure 1.3). On the basis of this rather late distribution, the antiquarians of the late 19th century



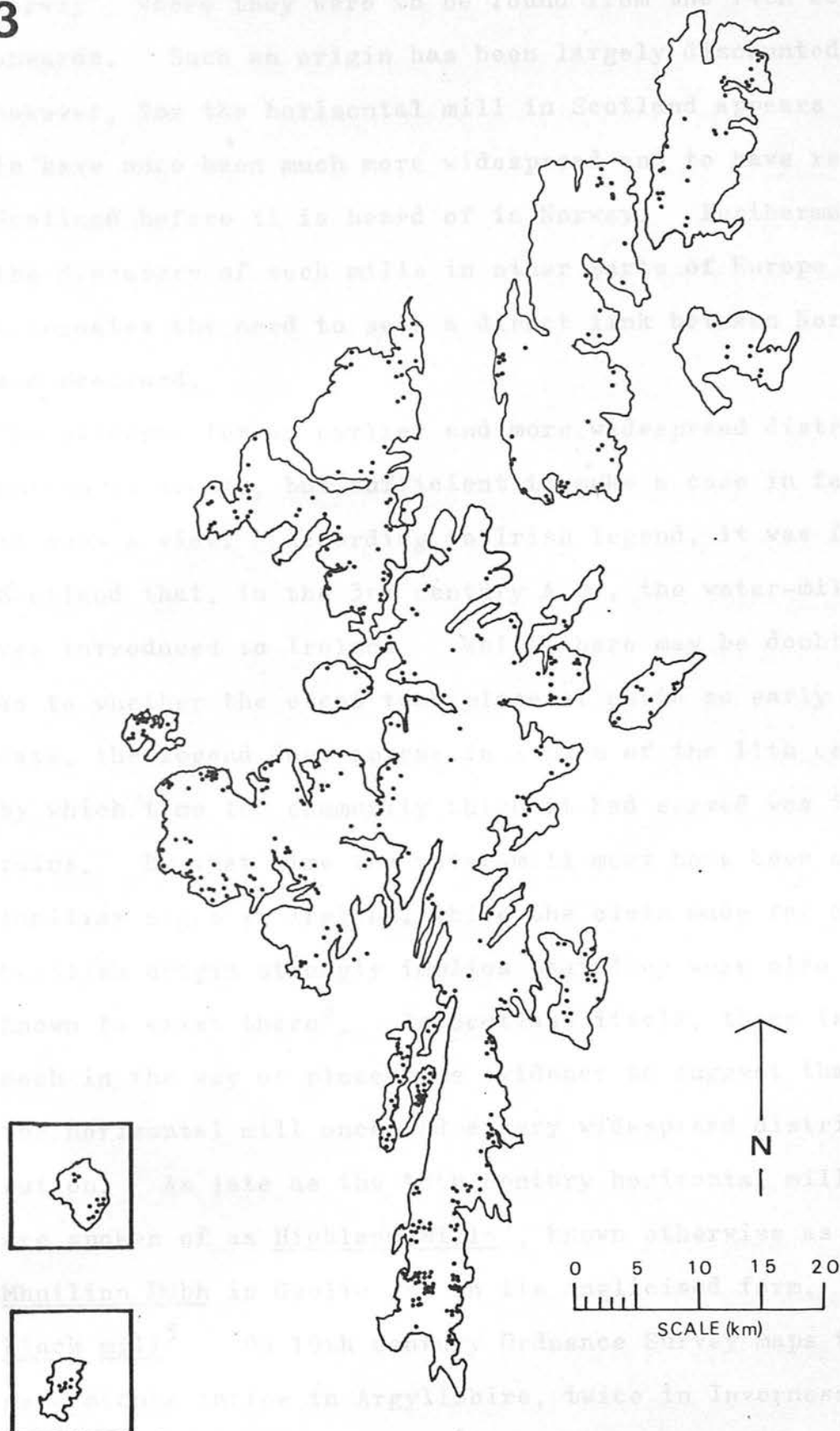
- 1: Hopper
- 2: Shoe
- 3: Clapper
- 4: Runner stone
- 5: Understone
- 6: Grutte
- 7: Lightening tree
- 8: Cross-tree
- 9: Sword
- 10: Tirfi
- 11: Trough
- 12: Feather
- 13: Ground sile
- 14: Bolster head
- 15: Sile

0 5 10 15 20
SCALE (cm)

1.2



1.3



concluded that horizontal mills had been introduced from Norway¹, where they were to be found from the 14th century onwards. Such an origin has been largely discounted² however, for the horizontal mill in Scotland appears to have once been much more widespread and to have reached Scotland before it is heard of in Norway. Furthermore, the discovery of such mills in other parts of Europe eliminates the need to seek a direct link between Norway and Scotland.

The evidence for an earlier and more widespread distribution is scanty, but sufficient to make a case in favour of such a view. According to Irish legend, it was from Scotland that, in the 3rd century A.D., the water-mill was introduced to Ireland. While there may be doubt as to whether the event took place at quite so early a date, the legend does appear in a poem of the 11th century, by which time the community which it had served was in ruins. By that time the water-mill must have been a familiar sight in Ireland, while the claim made for a Scottish origin strongly implies that they were also known to exist there³. In Scotland itself, there is much in the way of place-name evidence to suggest that the horizontal mill once had a very widespread distribution. As late as the 18th century horizontal mills are spoken of as Highland Mills⁴, known otherwise as Mhuilinn Dubh in Gaelic or, in its Anglicised form, black mill⁵. On 19th century Ordnance Survey maps the name occurs thrice in Argyllshire, twice in Invernessshire, and once in Caithness⁶. A black mill occurs

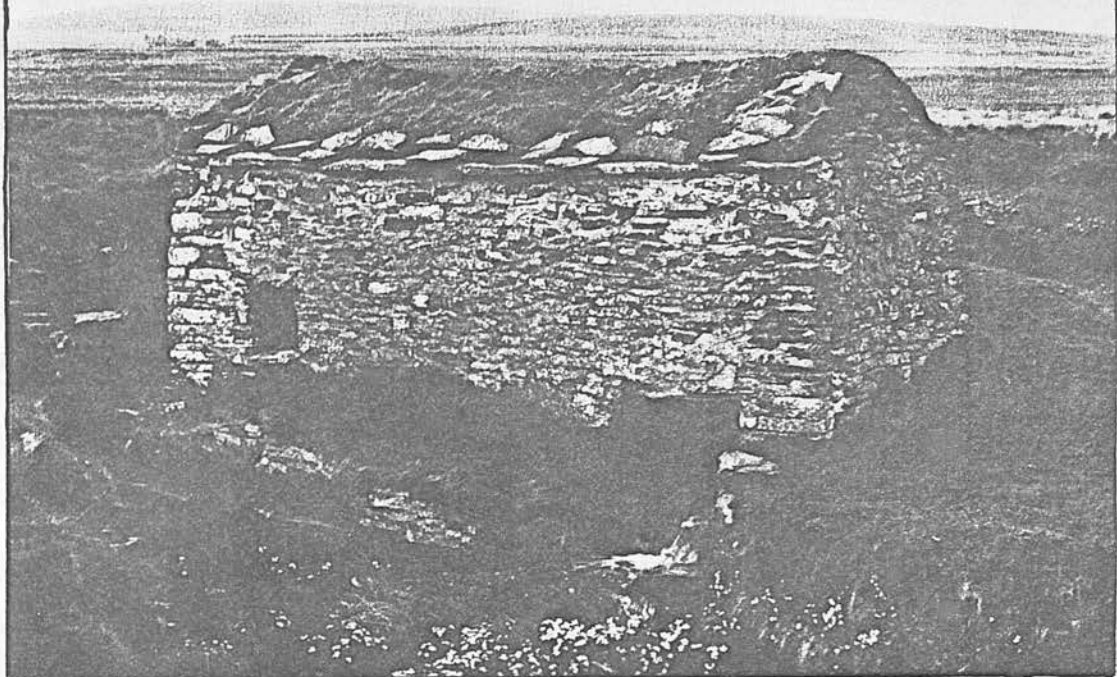
in a 17th century rental of LochTay-side, Perthshire⁷, and it has recently been claimed that all the mills then in use in that area were of the horizontal kind⁸. At other localities, throughout the Highlands, place names incorporating "mill" elements are to be found on 19th century Ordnance Survey maps. Considering the late introduction of the vertical mill to much of the Highlands, the very isolated positions in which some of the names occur, and the fact that these Gaelic place names are usually applied only to sites and not to functioning mills, it seems probable that they refer to the sites of former Highland mills, or mhuilinn dubhs (figure 1.4). Another link can be found between the Gaelic-speaking Scots and the horizontal mill. A paper dated 1534 refers to an already defunct mill in Angus as "ane mylne of Foyell callit the Scottismanis mylne, alias the ladill myll"⁹. Laddle mill, a term known from elsewhere to signify a horizontal mill¹⁰, is here used as synonymous with "Scotsman's mill", the latter term presumably being used to distinguish it from the English, or vertical, mill. A valuation dated 1684, relating to a mill in the eastern Grampians, is unmistakably that of a horizontal mill, for while stool, runner-stone, bed-stone, hopper-spindle and laddles are all detailed, there is no reference to inner- or outer-wheels, axle-tree, cog-wheel or trinnles, all of which would be found in a vertical mill¹¹. Two mills in Aberdeenshire, and one in Banff bear the name "Scotsmill"¹² while "laddle mills" are recorded as still in use in upland Aberdeen-

1.4



shire during the 19th century¹³. A legend relating to Glenquoich, Deeside, and quoted by Dick-Lauder, centres on such a mill, although its being managed by a Lowlander is somewhat anachronistic¹⁴. Goudie cites 18th and 19th century examples in Caithness, Sutherland and Mull¹⁵. At Dounby, Orkney, a horizontal mill still works, and is now preserved by the Department of the Environment (figure 1.5). Though not conclusive, these scattered references to horizontal mills suggest very strongly that, at some time in the past, they were to be found throughout the Highlands. As far as the period 1550 - 1730 is concerned, it would seem that such mills were still in use in Gaelic-speaking areas, and in the Northern Isles, although proof of such a claim would require a great deal of archaeological work; even then, dating of excavated sites could prove difficult. As for Lowland Scotland, there is no evidence of there ever having been any horizontal mills; while the Highlands had been occupied by Goidellic-speaking Scots since at least 500 A.D., the Lowlands were peopled by Brythonic-speaking Britons, with Anglo-Saxon population superimposed at a later date. Although the horizontal mill is known to occur elsewhere in Goidellic-speaking areas such as Ireland, it is not to be found anywhere in Brythonic areas, such as Wales. Indeed, it is tempting to see the horizontal mill as a feature of Goidellic culture, and the vertical mill as Anglo-Saxon. Remains of vertical water-mills, dating from the Roman occupation, have been found along Hadrian's Wall, but though con-

1.5



1.8



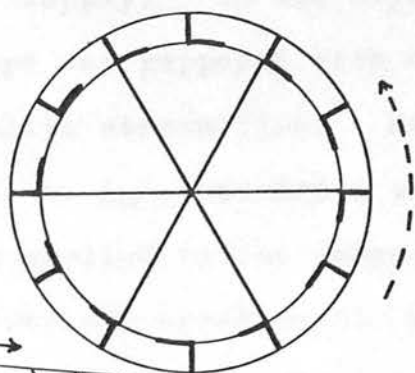
temporary with the Brythonic occupation of Southern Scotland, there is no reason to associate the latter peoples with the use of the vertical mill. The two groups of long-surviving horizontal mills in Lewis and Shetland appear initially to be fundamentally similar, although fieldwork has revealed differences in construction. No example of a Lewis mill has been found in which the walls have survived much above stone floor level; even at well preserved sites such as Mangersta (NB007303) and Cliff (NB079360) where millstones can be found in situ, the rule holds true. It is unlikely that the stonework has been removed for use elsewhere - in the western part of Lewis stone is anything but scarce; what seems more likely is that the upper part of each mill was built of turf and has subsequently rotted away. The remains of Shetland mills on the other hand, are much more substantial, often retaining not only their stone walls, but also their turf roofs, as on Papa Stour (HU163606) and at Huxter (HU173572). A handful of Shetland mills have recently been restored to working order.

Vertical Mills

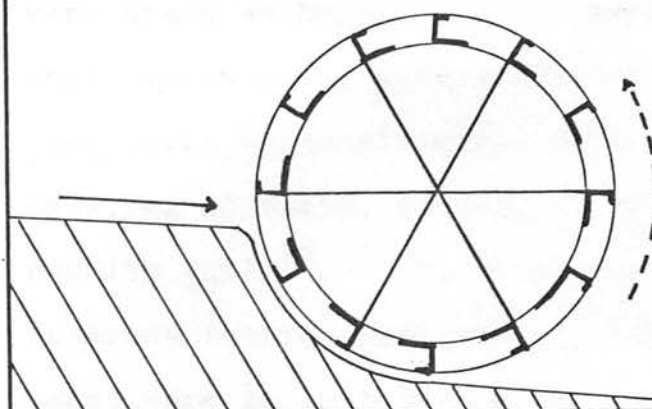
Common though the horizontal mill may have been, its use was confined to grinding meal, and even if there had been the wish or the need to use it for any other purpose, the absence of gearing and the low power generated would have rendered it quite unsuitable for any other purpose, at least until the development of the turbine. Only

the vertical mill could offer the basis for more powerful and versatile variations, for by using gearing, it was possible to alter the plane in which shafts rotated and to increase or decrease their speed of rotation relative to that of the water-wheel. A horizontal axle-tree, fitted with cams, could be used to raise beaters then to let them fall again under the force of gravity. Simple as this device may have been, it was to form the basis of almost every new application of water-power during the period 1550 - 1730: the fulling of cloth, the pulping of rags for paper, the forging of iron, the crushing of ore and the working of bellows all relied on this basic modification to traditional water-mill technology. A horizontal axle-tree could also be used to carry the chains which raised water and the ropes that raised coal from mines. The vertical water-wheel could be modified to take advantage of differing sizes of fall. Thus, where the fall available was small, an undershot or breast-shot wheel could derive its power from the impact of the water; where a greater fall was available naturally, or made available artificially, an overshot wheel, fitted with buckets, could utilise not only the impact of the water but also its weight (figure 1.6). While undershot or breast-shot wheels fitted with starts and sawes were by far the most common in Scotland, more efficient over-shot wheels were also in use during the period 1550 - 1730 notably in draining the mines where large, powerful wheels were employed (figure 5.2). More detailed consideration is given to the technology of vertical mills in the chapters

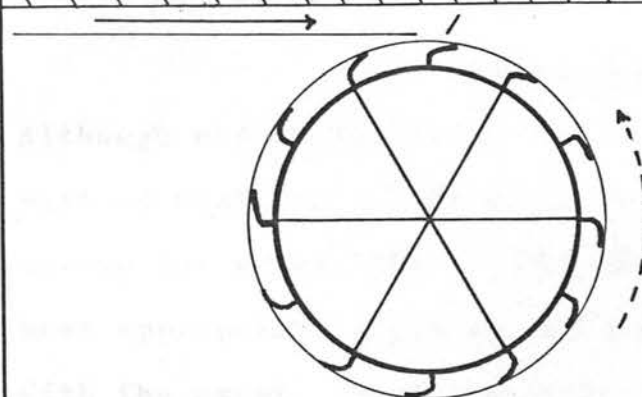
1.6



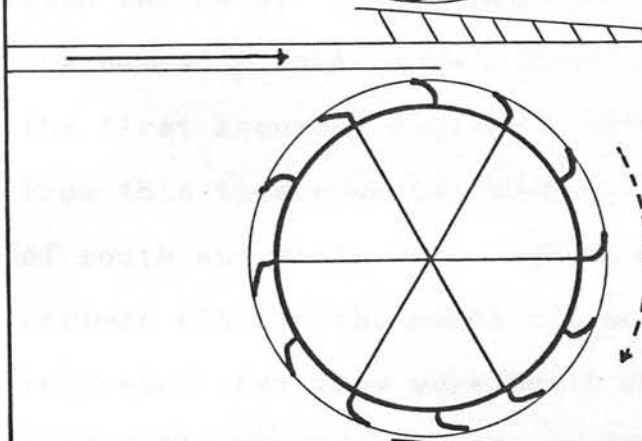
Undershot



Breast-shot



Pitch-back



Overshot

which follow.

If a mill were to function, some provision had to be made for a water supply. In the days before land drainage the landscape was peppered with marshes and lochans, which helped regulate stream flow. Normally an artificial water-course or lade was drawn off from a stream and, having been applied to the water-wheel, returned thereto. Under the simplest arrangement, part of a stream was diverted to a mill without the use of a dam. Such mills were known as burn mills. Where several springs and small streams lay within the catchment area simple gather-dams might be constructed, while on larger streams a dam-dyke of peats, divots, or loosely piled boulders was usually built¹⁶. The most spectacular examples involving damheads several hundred feet long and lades several miles long, were to be found in the coal industry (vide infra p. 87)

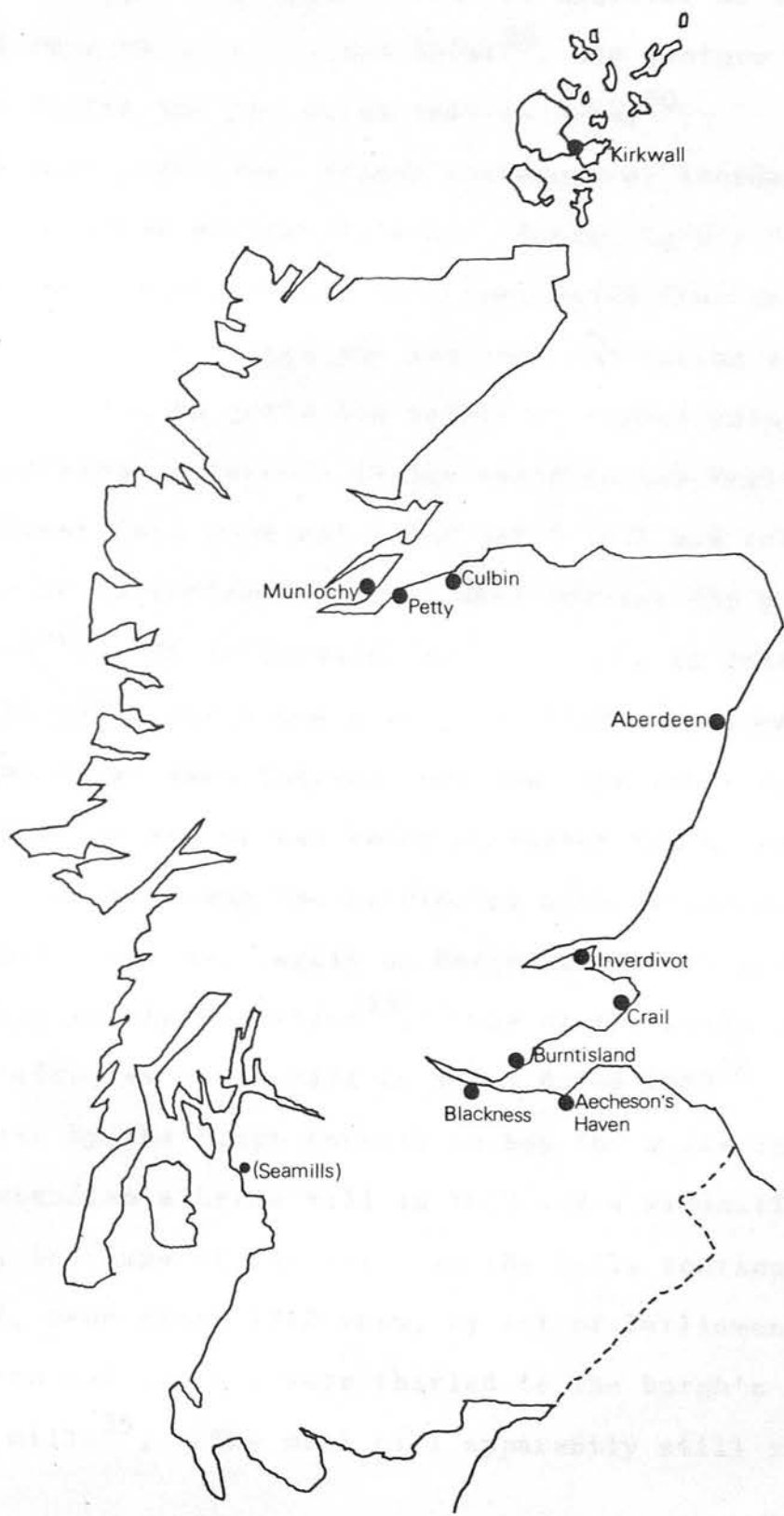
Tide Mills

Although not exclusive to the period under consideration, most of Scotland's tide mills originated in and operated during the years 1550 - 1730, so this is probably the most appropriate point at which to consider their use.

With the exception of one rather doubtful reference in the Domesday Book it is not until the 16th century that the first recorded English tide mill appears, in Devon¹⁷.

From this time onwards, such mills were built on the coasts of south and south-east England but, with one late exception¹⁸ nowhere else in the north of the country. It has been suggested that they were built only where streams with good falls were inadequate or completely lacking but a

less tangible cultural factor may also be involved. In either case, tide mills, known in Scotland as sea mills, did occur north of the Border, and from an early date. In the absence of positive proof, it can only be assumed that the Low Countries were the common source of both English and Scottish tide mills. Certainly their distribution along the eastern seaboard of both countries supports such an assertion (figure 1.7). The earliest reference to sea mills is to a pair of mills at Inverdivot, Fife (N^o 4127) which are listed in a charter under the Great Seal, dated 10th September 1526; the description given, "molendini maritum vulgariter nuncupat seymyllis" is almost certainly a reference to tide mills¹⁹. References to the mills continue until the early 19th century, by which time a third mill had been added. No other details are known of the mills²⁰. In 1526, the first year in which the Inverdivot mills came to light, licence was granted to Alexander Acheson to build a harbour near Prestonpans, East Lothian²¹. In the confirmation to the charter, permission is given to build tide mills inside the harbour²², an option which appears to have been taken up by 1587, when the Register of the Great Seal mentions two sea mills there, both employed in grinding meal²³. The mills had a long and useful life and in the 1790's were grinding flint for local potteries²⁴. Another pair of sea mills, for grinding meal, were built on the green at Blackness, West Lothian, by Alexander, Earl of Linlithgow, c.1608²⁵. These mills are referred to in 1629 and again in 1632 and 1642²⁶, but thereafter



no more is heard of them until 1722, by which time they were said to be in ruins²⁷.

In 1621 a pair of tidal meal mills were projected and built at great expense near the quayside of Aberdeen²⁸, but although they appeared in the Register of the Great Seal some seventeen years later²⁹, the venture seems to have failed and the mills left to decay³⁰.

More successful than either Blackness or Aberdeen were the sea mills of Burntisland. Young, in his "History of Burntisland", infers that they dated from the late 16th century and that one was used for sawing timber, but he fails to quote his source on either point³¹.

The earliest reference to the mills in the Register of the Great Seal does not occur until 1638 and even then there is no indication as to what purpose the mills served³². It is certain, however, that at least one of the mills was a grain mill, to which the inhabitants of the burgh were thirled, and that the other either started out as, or was later converted to, a saw-mill.

According to Young the astringency also extended to the saw-mill, but here again no documentation is produced to support the assertion³³. One of the mills is indeed identified as a saw-mill on a map dated 1843³⁴. Despite efforts by the burgh council to buy the mills in 1655, to establish a horse mill in 1670 and a windmill in 1683, thirlage of the burgh to the mills continued to stand, even after 1712 when, by Act of Parliament, the maltmen and brewers were thirled to the burgh's steel malt mills³⁵. The meal mill apparently still stood in

1961, though the mill wheel had been removed some four years previously³⁶. According to the New Statistical Account, the mill was capable of grinding for fourteen hours per day³⁷. Sea mill occurs as a place name in Ayrshire (NS2047), but there is no documentary proof that they were, in fact, tide mills. One such mill was certainly operating in Crail parish, Fife, during the 1790's³⁸ and another in Orkney in the 1890's³⁹ (figure 1.8), but by far the best documented site is the sea mill of Petty, Inverness-shire. The earliest reference to this mill is in 1682, when the millers were accused of "sabbath grinding". A valuation of machinery, taken in 1754, is particularly informative, and runs as follows:

	£	s	d	40
To the utter wheels and axle trees	5	12		
To the inner wheel	4	16		
To the 4 bolstors		16		
To the four miln stones	30	6		
To the crubs and happers	2	16		
To the two bridges, two clos two breast trees and the two bands	3	4		
To the two cradles	1	4		
To all the iron work	17	6		
	<hr/>			
	£	66		

The two outer-wheels and the four millstones provide a likely explanation as to why so many Scottish tide mills are referred to as being in pairs: later evidence confirms that both incoming and outgoing tides were employed at Petty⁴¹ and this was very probably the system used elsewhere. The upkeep of the dam-dyke at Petty was the joint responsibility of the Earl of Moray's tenants, each being

assigned a section to keep in repair⁴². The mill ceased to work c.1825 and was allowed to fall into decay⁴³. Overall, the contribution which sea mills made to water-powered industry as a whole was small, despite the widespread interest shown in them in the 17th century. Locally however, they could provide a source of motive power in areas otherwise poorly served, notably the eastern coastal burghs. At Aberdeen, the burgh's milling requirements had led to the erection of a windmill prior to 1621⁴⁴, while in Dundee the inadequacy of the burgh's Castle Mills and windmills was such that under a charter of 1641 the corporation was granted liberty to erect sea mills. Most striking, however, was the need for power in the Prestonpans area, where, besides the sea mills at Morrison's Haven, windmills and water-mills driven by mine adits, were in use by the 17th century.

The Emergence of the Millwright

Unlike the traditional meal and fulling mills, the new commercially-orientated users of water power who appeared during the period 1550 - 1730 had no suckeners to draw upon when a breakdown occurred. In the absence of such a tied labour force, a demand was created for craftsmen such as masons, joiners and millwrights who could be called upon to build and repair mills as and when required. By the end of the period, the practice of employing wage labour had extended back to grain mills (p. 25); James Meikle, a humble miller in East Lothian, had shown his skill as a millwright by applying the new grain-mill technology which he had found in Holland, while his two

sons, Andrew and Robert, were receiving the training in millwrighting which was to make them the greatest millwrights that Scotland has ever produced. Elsewhere in Scotland, the skills accumulated by millwrights were to stand the country in good stead when, in the following century, developments in technology provided many new opportunities and a well-trained class of Scottish millwright was able to make full use of them and contribute new ideas of their own.

GR 12/9/33 (1887) The Black Mill of Clocheran, paid 3 bulls meat in rent.

Information supplied by Peter Hill, Department of Economic History, University of Edinburgh.

GR 653/44

GR 12/9/33 (1887) 100

GR 12/9/33 (1887) 100

GR 12/9/33 (1887) 100

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GR 12/9/33 (1887) 100

GR 12/9/33 (1887) 100

- 1 : Goudie, G. "The Horizontal Watermills of Shetland"
PSAS XX (1885-6) 294
- 2 : Dickinson, H.W. & Straker, E "The Shetland Watermill"
TNS XIII (1932-4)
- 3 : Gribbon, H.D. "The History of Water Power in Ulster"
Newton Abbot 1969. 12
- 4 : OSA VII 570. Reay, Caithness
- 5 : OSA XIV 149. Kilninian, Argyll
- 6 : OS 6"/mile 1st Edition. GR's NR946958, NN003306,
NF778535, NH855035
- 7 : SRO GD112/9/33 (1687) The Black Mill of Clocheran
paid 5 bolls meal in rent.
- 8 : Information supplied by Peter Hill, Department of
Economic History, University of Edinburgh.
- 9 : SRO GD83/45
- 10 : TH&AS (1873) 300
- 11 : SRO GD205/ Box 23
- 12 : OS *ibid.* GR's NJ563186, NJ829138, NJ608653
- 13 : "Dictionary of the Older Scottish Tongue" Edinburgh/et seq 1937
- 14 : Dick-Lauder, Sir T. "An Account of the Great Floods
of August 1829, in the Province of Moray and Adjoining
Districts" Edinburgh 1830. 365
- 15 : Goudie, *op. cit.* 282-5
- 16 : SRO GD110/740 (peats and divots); SRO GD45/18/162
(stone)
- 17 : Bennett, R. & Elton, J. "The History of Corn Milling"
2 vols. Liverpool, 1898-9, and 4 vols. New York N.D.
II.218

- 18 : Ibid, II 220
- 19 : SRO GD1/128/2
- 20 : IRA Fife, 42 (1560)
SRO GD1/128/9 (1594)
RMSRS XI 619 (1664)
SRO GD1/128/44 (1791), /47 (1802), /48 (1803)
- 21 : Graham, A. "Morrison's Haven" PSAS XCV (1961-2) 300
- 22 : RMSRS III 2362 (1541)
- 23 : RMSRS V.1307 (1587)
IRA Haddington 50 (1609), 136 (1632), 352 (1684)
- 24 : OSA XVII 74 Prestonpans, East Lothian
Forrest, W. (Map of) Haddingtonshire 1799
- 25 : RMSRS VI 2195 (1608)
- 26 : Dalryell, Sir J. & Beveridge, J. (Ed's) "Binns Papers
1320-1864" SRS LXX (1938) No. 125
RMSRS VIII 1977 (1632)
NSA II 76 Carriden, West Lothian
- 27 : Dalryell & Beveridge, op.cit. No. 550
- 28 : Kennedy, W. "Annals of Aberdeen" 2 Vols. London 1818
I.142
- 29 : RMSRS IX 860 (1638)
- 30 : Kennedy, op.cit. I 410
- 31 : Young, A. "A History of Burntisland" Kirkcaldy, 1913
30 - 31
- 32 : RMSRS IX 795 (1638)
- 33 : Young, op.cit. 31
- 34 : Ibid. 31
- 35 : Ibid. 32-33
- 36 : Pencilled footnote in Edinburgh Central Library's
copy of Young, op.cit. 31

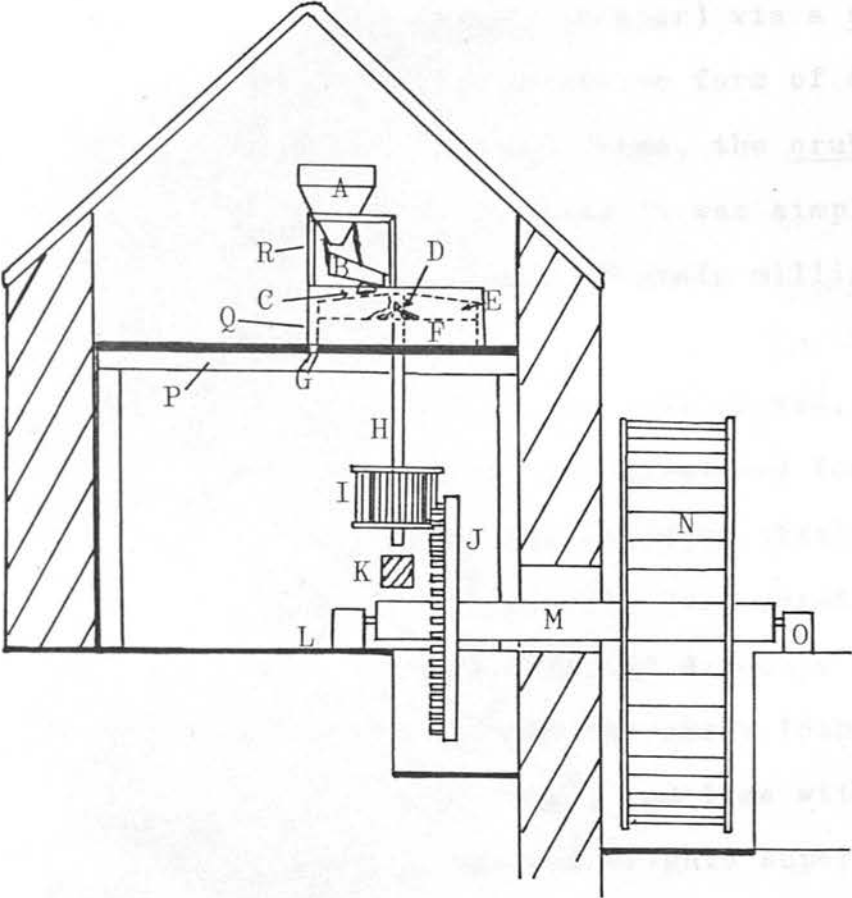
Rural Meal MillsTechnology

Without any doubt, it was to the grinding of oats and bere that water power was first applied in Scotland: several such mills appear in the earliest Scottish charters of the 12th century¹, at least two hundred years before the earliest references to cloth fulling mills².

The machinery used in grain milling, or at least the water wheel and gearing, formed the basis for all subsequent types of water mill and therefore deserves to be covered in depth.

A wooden water or outer wheel, generally low breast-shot, was fitted with starts and sawes, set at an angle to each other (figure 2.1). A wooden axle-tree, supported by inner- and outer-headstocks, and banded at each end with iron, passed through the centre of the wheel; a clasp-arm frame held it in position. Near to the inner end of the axle-tree was fixed, in a similar frame, the inner or cog wheel, around the inside edge of which were set a ring of pegs which meshed with the spars of a lantern pinion or trundle. The trundle was fitted around a short wooden spindle or stone pinion, supported at its lower end by a bridge-tree, and carrying at its top end a projection, in iron or steel, referred to as the rind. This fitted into a socket in the eye of the upper- or runner-stone, while the lying- or bed-stone, through which the spindle passed, was held stationery by a

2.1



- | | |
|----------------------------|--------------------|
| A: Hopper | J: Inner wheel |
| B: Shoe | K: Bolster tree |
| C: Clapper | L: Inner headstock |
| D: Rind | M: Axle-tree |
| E: Runner stone | N: Outer wheel |
| F: Bed stone /nether stone | O: Outer headstock |
| G: Mill eye | P: Stool |
| H: Spindle | Q: Hoops |
| I: Trundle | R: Cradle |

heavy wooden framework. Often the stones were encased in wooden hoops or rings, which prevented the grist, be it shillin or meal, from spilling out onto the stool, or platform, on which the stones were supported. Since most rural mills had only one pair of stones, the space between them had to be altered for the differing requirements of shilling and mealing; such an alteration was performed by means of a sword, a lever which passed down through the stool and which was hinged to one end of the bridge-tree. Grain and shillin were fed to the eye of the runner-stone from a happer (hopper) via a shoe, the latter being activated by a primitive form of damsel, known as the clapper; a wooden frame, the crub, supported the happer, although in some cases it was simply hung from the roof. A detailed glossary of grain milling terms appears in Appendix A.

Just as the machinery of the corn mill showed, for the most part, a dependence upon unmanufactured locally available materials, so also did the building itself. Roofs, carried on a framework of branches, were normally of thatch, heather or divots³, while rubble and divots were the customary materials for walling; by the early 18th century salte was being used in roofing⁴, and lime with stones in walling, with skilled masons and wrights supervising mill construction. However, over much of the country, mill construction, including damwork, was achieved through the reluctant unskilled labour of the suckeners. In urban areas, where the need to keep the mills operational was particularly great, and the performance of services by

the suckeners unknown, much greater care was taken in building dams⁵. By the early 18th century outside labour was being employed in dam construction in rural areas, as at Kinnaird Mill, Angus, where, in 1719 a £100 contract was signed for such a project⁶.

Distribution

During Mediaeval times the success of the meal mill, or corn mill, as it is commonly known in Scotland, was such that by the period under consideration something like 3,000 of them were in active use, with examples in all but the most isolated or sparsely populated parts of the country. Even in Highland Scotland, contrary to popular belief, the water-mill was well established by the late 16th century. With the exception of those areas too lightly cultivated or populated to support a mill, the only areas from which they were largely absent were those above 750 feet, presumably the upper limit of cultivation.

In water-mills the landowner possessed, for the first time, a means whereby an income, over and above that accruing from the land itself, could be obtained from a manufacturing process. First, however, a local monopoly had to be established.

Competition from the Quern

Before the monopoly could be established, a certain amount of ground work had to be done. Long before the water-mill had reached Scotland, the quern had come into use; throughout the period under consideration it continued to offer a cheap, if laborious alternative to the

water corn mill, especially where only small quantities were to be ground. The breaking of querns, under orders from Barony or other courts, was a common measure. Such was the action taken at Mid Calder in 1598, when a fine of 40 shillings Scots (about 17p) was imposed on anyone found in possession⁷.

Nevertheless, circumstances did not always permit such sweeping gestures: at the Mill of Fearn, Easter Ross, the water supply was so precarious that as late as 1720 it was found necessary to permit the use of querns during July, August and September, they being handed in during early October, to protect the mill's thirlage until the following summer⁸.

Establishing a Thirlage

Once a mill had been built, it became necessary to guarantee its use, and for this a thirl or astringtion had to be established over a certain area, normally the estate of the mill proprietor. In most circumstances the area thus thirled would yield sufficient multures, or dues, to justify the building or leasing of a mill; occasionally however, the income from a mill was too small to ever yield an adequate return, on account of the limited extent of an estate or because of existing thirlages to other mills. The thirl of Old Cambus mill, Berwickshire, was restricted to three husbandlands in Old Cambus itself⁹, while the rent of Mill of Inverdunning, Perthshire, had to be reduced from twelve bolls of victual to four, for so small was the thirl that the dues paid for grinding came to less than the former rent¹⁰. At Cransmill, Aberdeen-

shire, the thirl was of sufficient extent, but the rent still had to be reduced, from 80 to 70 Merks Scots, "upon certain consideration that the s(ai)d sucken of the s(ai)d miln, at least meikell of it, is oft tymes waist and cannot bear the rent th(e)r(e)of"¹¹. Not surprisingly, and contrary to Court of Session rulings¹², thirlages were sometimes amalgamated, although the opposite process, whereby new thirlages were created within existing ones, was still taking place in the late 17th century.

Where a thirl included lands belonging to another landowner, it was not unusual for the latter to encourage those of his tenants within the thirl to use his own mill instead, even to the extent of building one specifically for their use. Once such a step had been taken, the Court of Session, a slow and costly arbiter at the best of times, could do little to help, even going so far as to rule that a mill, once built and set a-going for 48 hours, could not be demolished¹⁴. Hardly less consoling was their judgement in the case of McDougal v. McCulloch. During the 1680's McCulloch of Moole built a mill at Slock, within the thirl of McDougal of Logan's Clonyard Mill, Wigtownshire. McDougall took the case to the Lords of Session, who, finding McCulloch thirled to the mill of Clonyard, ruled that Slock Mill be demolished. However, on examination the former mill was found to be unfit to serve, and its successor, a windmill, was not recognised as holding the thirl. Far from being demolished, the Mill of Slock was still going strong at the time of General Roy's survey, some sixty years later¹⁵.

Types of Thirlage

Depending on the location of a mill, and the nature of the lands which it served, one of three different types of thirlage could be established. Unique to burgh lands was thirlage of invecta et illata, under which corn consumed within the thirl had to be manufactured at the burgh mill, regardless of where it was grown. In Royal Burghs control of the mill lay with the Incorporation, but in Burghs of Barony it generally remained in the hands of the feudal superior. Burgh mills will be considered in greater detail later in this chapter.

In rural areas, two types of thirlage obtained. Under the lighter of the two, known as the thirlage of grind-able grain, the astringiction was limited to oats and barley grown within the thirl for household use. Since such a thirlage did not prevent suckeners from buying in meal from outside, they could, in theory at least, evade the thirlage altogether by depending solely on this source for their own needs¹⁶. More onerous was the thirlage of omnia grana crescentia, under which all grain grown within the thirl, excepting only seed corn and horse corn, was liable to astringiction. In 1565 the Court of Session made allowances whereby grain could be sold on the open market to raise funds for such payments as teinds; grain enough to pay for threshing and plough repairs was also exempted. However, their rulings generally failed to be implemented, and on subsequent occasions even the Court itself failed to take account of these allowances¹⁷.

Multures

While the creation of a thirlage established a monopoly it did not, in itself, create a source of income for the mill owner. Only the imposition of a duty, over and above the real expense of grinding, could do that. In Scotland such a duty was known as multure, an imposition which frequently led to confrontations between miller and mill owner on the one hand and suckeners on the other. All the grain brought to the mill carried a multure, normally at a rate of 1/24th to 1/13th of the total. In addition to this sum small, supposedly voluntary, payments were made to the miller (bannock) and to his servant or knave (knaveship). Where only the miller himself served the mill, the latter term was often used for his payment. These two payments together represented about half that deducted as multure.

Much of our knowledge of multures comes from the writings of the late 18th century, and by the same token so do our attitudes to them. However, evidence from the period 1550 - 1730 does not altogether tally with such views; indeed, there is reason to believe that neither were multures such an oppressive and universally exacted tax, nor was the miller such an arch-demon as later writers would have us believe. It would appear that the practice of abstracting grain was fairly widespread, and that grain so abstracted was manufactured at other, though not necessarily more accessible mills, at the lower "outentown" multure rate. This view is corroborated by the fact that most mills offered this rate to those from outwith

their thirl; were outentown rates not aimed at those thirled elsewhere, then one can only assume that they were paid by those not thirled to any mill.

The practice of abstracting could seriously detract from the value of a mill, and if, as was generally the case, the mill was set in tack, this would cut into the income from which the miller paid his rent. At the end of his tack, the miller could find himself unable to make the necessary repairs and the mill, its value impaired by abstractions, would have to be let at a lower rate¹⁸.

Through the medium of the Barony Court efforts could be made to recoup the losses caused by abstractions and to prevent further losses, but the success of such measures depended on the co-operation of the accused. Should he confess, or fail to appear, a fine or unlaw of £2 to £10 Scots was imposed, plus a volume of corn equal to double that which would have been paid in multures. On the other hand, anyone who appeared at Court and denied the charges stood a good chance of being absolved. In 1712. when the tenant of the Mill of Guthrie, Angus, raised a complaint against certain suckeners, they denied all charges, forcing the miller to waive all past abstractions and settle for a strongly worded, but basically ineffectual re-enactment of the Act of thirlage, requesting them to keep to the mill in future¹⁹.

Maintaining the Mill

Besides paying multure and knaveship, suckeners were expected to perform certain duties in connection with the mill's upkeep. Many different tasks might be asked

of them: carrying home millstones²⁰, repairing damheads²¹, clearing lades²², thatching the mill roof²³, leading building materials²⁴ and carrying timbers such as axle-trees²⁵ were all performed by the suckeners of one mill or another. In 1621 the Court of Session ruled that the duty to perform such tasks was implicit in every form of thirlage²⁶. The Barony Court could call upon suckeners to perform services, but only those which were "used and wont". Services as outlined above have been viewed as particularly onerous but this is, again, the view of a later age. The bringing home of millstones, though time consuming, united the whole community, and involved the consumption of large quantities of free bread and ale before the millstone could be brought to rest at the mill. Nor was the journey so arduous as it might have been: a millstone, with a bough or wand slotted through the eye, could be trundled along the roughest of tracks without much effort. Here again, the miller was dependent on the active co-operation of the suckeners, a co-operation which was not always forthcoming. In 1627 the Barony Court of Colstoun, East Lothian, had ruled that, should the millers require new stones, they "sall bringe theme hame yearlie befor August, otherways na persoun to be astrictit or oblist to helpe thame with the saidis mylstanes....in tyme cuming"²⁷. In 1688 the suckeners of Kevock Mill, Midlothian, refused to carry millstones or pay a commutation²⁸. Not surprisingly, millers changed their stones as infrequently as possible, often working them down to an inch or two's thickness²⁹. After tenants in Stitchill Barony, Roxburghshire, had

refused to provide thatch for the estate's mill, a temporary arrangement had to be made, under which the miller and tenants were each to cast and lead half the quantity needed. When eventually a more permanent agreement was reached, it required the tenants to provide and lead straw for the mill, proportional to the extent of their lands. While they were also asked to make available divots, casting and leading had to be at the miller's own expense.³⁰

As for the provision of timbers, this was usually the joint responsibility of miller and mill owner, the former supplying small timbers and the latter the large ones³¹.

Where such arrangements did not exist, responsibility lay with the owner alone³². Occasionally, a sort of insurance was paid along with the rent, the proceeds of which could be used to pay for repairs to the mill³³.

In only a few cases did the suckeners need to provide help, and even these were confined to occasions when the amount of work to be carried out was above the capacity of the miller himself.

Generally, it would seem that mill services were only performed grudgingly, and were so ill-executed that, by the end of the period, a money commutation was obtained wherever possible, with hired labour and skilled craftsmen taking the place of the reluctant suckeners³⁴.

The Miller's Obligations

It has already been suggested that so long as so many mills continued to serve so few people, the creation of thirlages and the imposition of multures were necessary

evils, especially if the mill were to be set in tack. The need to prevent, or at least restrict abstractions was a real one, but the rulings of the Barony Court were not always effective, nor did they indiscriminately favour the miller at the expense of the tenantry. On the contrary, the miller had very definite obligations towards the thirl, as is attested to by both mill tacks and court records.

As often as not, the miller was expected to collect corn for grinding³⁵. Despite the confusion which reigned with respect to measures³⁶, efforts were made to standardise those used in any one area, and to prevent fraud. The miller at Shaws Mill, Fife, had to "accept and imbrace his lo(rdshi)p's owine metts and measures for metting of the cornes and maill"³⁷, while at Colstoun, in 1643, "ane trew visite and sicht" was taken of the firloths, pecks and dishes used at the nearby mills of Bothans and Bolton, measures which served as standards for those used at the Over and Nether mills of Colstoun³⁸. Clauses in successive tacks of Shaws Mill give a particularly detailed account of what might be expected of a miller. Besides the standardisation of measure already referred to, the miller was to "grind, mill and kill* the haill grindable cornes" grown in the Barony of Raith, taking as much care with the tenants' corn as with the master's. The meal produced was to be as good as that from any other mill within a four-mile radius. Should the corn be in any way "spoylt or damnified" by him, he was to provide com-

* Anglice - kiln

pensation, "at the sight of the Noble Earle or his Chalmerlane"³⁹. The runner-millstone was to be provided with an iron girth, the water-wheel kept free of backwater, and the mill kept locked at night⁴⁰. Anyone appointed as an under-miller had first to meet with the approval of the mill owner, and was expected to work at a wage rate set by him. Once notified by a suckener, the miller was expected, the following day, to collect grain for milling from anywhere within the barony, and to return it once ground. Malt for the Earl was to be ground free of charge⁴¹.

At another of the Earl of Melville's mills, Monimail, malt could be taken elsewhere if the miller was unable to grind it at twenty-four hours' notice⁴². At Quarryford Mill, East Lothian, two men had to be kept for serving the mill and kiln⁴³, while at most mills each client had to "stand his rume" or wait his turn, those from within the thirl having preference over those from out-with, even if the latter had arrived at the mill first⁴⁴. All in all, the lot of the suckeners was much better than is commonly assumed.

Occupational Hazards

Besides the obligations outlined above, the miller faced other impediments. A miller whose work failed to please might be subjected to physical violence⁴⁵, or brought up before the Barony Court⁴⁶, the members of which, it should be remembered, were chosen from within the ranks of the tenantry, and were also, therefore, suckeners of the mill⁴⁷. In court, the inadequacy of a mill could

be adequate grounds for abstraction⁴⁸.

Nor was it just the suckeners whom the miller had to fear. The 16th, 17th and 18th centuries were violent times in Scotland, and it was often the mill, a necessary element in the manufacture of food and an important source of income for the laird, that bore the brunt of the violence⁴⁹. One common practice was to remove the sluice-gate or break down the dam-head but other parts of the mill, both structural and mechanical, might be broken or carried off. In 1611 one John Forrest came by night to the Mill of Crawfordjohn, Lanarkshire, broke the "utter and inner quheillis, axtrie, spindle, happer, trouch..... rinnand and lyand stanes" and finally demolished the building. The mill was subsequently rebuilt, only to be burnt down by the same person⁵⁰. While the destruction or disablement of a mill might be a source of inconvenience to the suckeners⁵¹, it was a disaster for the miller, who could no longer obtain the dues which provided his livelihood and paid his rent.

The periods during which a mill could operate were limited by other factors too. The Protestant Church frowned upon Sunday working, a practice which was particularly common in dry areas with limited water catchment⁵², and although its views were embodied in an Act of Parliament⁵³, the practice remained sufficiently common to require a re-enactment some twenty years later⁵⁴.

Much more serious an "Act of God" was the scarcity or superabundance of water, a problem which could be especially harmful for "burn mills" which had no storage

capacity. It has already been shown that the inadequacy of a mill's water supply could be used in defence of abstractions (p. 28); the only group to whom this line of defence was closed were those who were already abstracting when the supply had dried up.⁵⁵ Despite the Court of Session's ruling to the contrary, exemption from thirlage during drought was a widespread practice⁵⁶, as illustrated by the following clause, written into a thirlage agreement by the feuers of Maybole. Ayrshire:

"And gif the milne shall happine not to be in capacitie threw drouth and want of water, to grind all the corn and malt that shall be brought be ws to grund th(e)rat, then, and in that caice, it shall be leisuin to ws to take als much of our cornes and malt as the said milne shall not be able to worke, to any uthr milne, to be grund th(e)rat."⁵⁷

Storm damage, frost and backwater in winter could be just as disabling as drought in summer, offering equally legitimate grounds for abstraction. In Angus, the suckeners of the Mill of Guthrie were free, in such circumstances, to go elsewhere to grind corn for household use, or to borrow an equal quantity of meal from the miller, until such a time as the mill was once more capable of grinding.⁵⁸

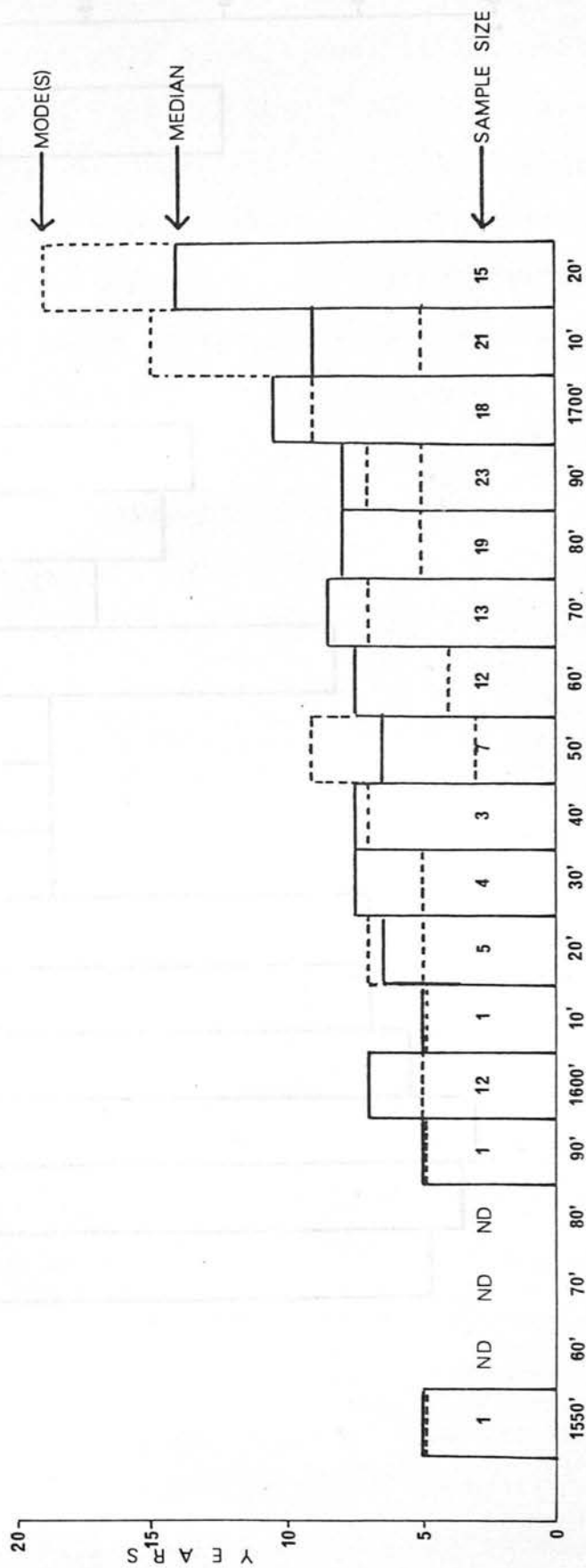
If, for any of these reasons, the mill was out of action for any length of time, the miller could face substantial losses.

The Miller as Tenant

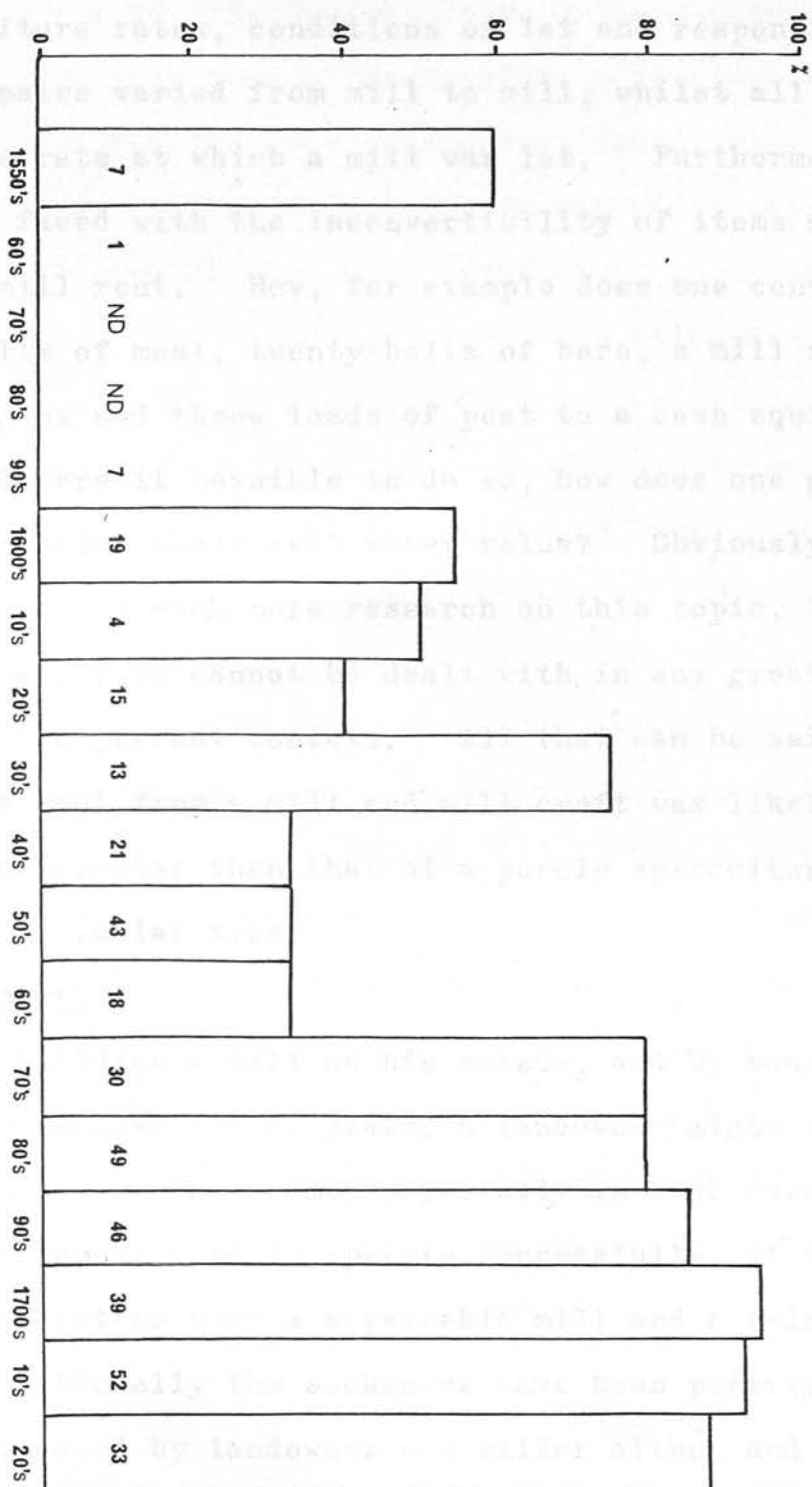
It is all too easy to forget that the miller, like the

suckeners, was usually a tenant, and bore the same responsibilities to the landowner as did the rest of the tenantry. Mill tacks generally ran for three, five, seven or nine years, although feuing, liferenting, and long leases of up to thirty-one years were not unknown (figure 2.2) By the early 1700's longer leases were appearing, with nineteen-year terms common by the 1720's. In payment of his rent, the miller was expected to find a wide range of produce: a typical rent might comprise twenty bolls of oatmeal, ten bolls of bere, a mill swine. twelve capons and twenty poultry. Among the additional items which might be expected were geese⁵⁹, eggs⁶⁰. linen cloth and yarn⁶¹, lambs⁶², wedders⁶³, butter⁶⁴, malt⁶⁵, tallow⁶⁶, wheat⁶⁷, bran⁶⁸ and salmon⁶⁹. Besides providing these, the miller had to carry out services such as arrage (ploughing)⁷⁰, provide a horse and sled or a sickle during harvest⁷¹ and carry a variety of commodities such as crops⁷², coal⁷³, peat⁷⁴, heather⁷⁵ and turfs⁷⁶. Besides his rent in kind, many a miller paid a cash sum or silver mail; from the 1670's onwards there was a rapid increase in the number of mills paying a cash rent. as commutation of rents in kind spread (figure 2.3). For example, at Oakwood Mill, Selkirkshire, a rent comprising sixteen bolls of malt, sixteen of meal, thirty-two kain fowls and a mill swine had been commuted to a cash sum of £269 6s 8d Scots by 1693⁷⁷. As for comparisons between mill rents at different times and in different places, the presence of so many unknown variables makes for enormous difficulties. The amount

2.2



2.3



← SAMPLE SIZE

of land let with a mill, the size of the thirl, prevailing multure rates, conditions of let and responsibility for repairs varied from mill to mill, whilst all could affect the rate at which a mill was let. Furthermore, one is faced with the inconvertibility of items making up a mill rent. How, for example does one convert twenty bolls of meal, twenty bolls of bere, a mill swine, twelve capons and three loads of peat to a cash equivalent? And were it possible to do so, how does one go on to establish their real money value? Obviously there is scope for much more research on this topic, but unfortunately it cannot be dealt with in any greater depth in the present context. All that can be said is that the rent from a mill and mill croft was likely to be much greater than that of a purely agricultural holding of a similar size.

Summary

By building a mill on his estate, and by monopolising the manufacture of grain, a landowner might hope to generate more income, especially in cash form. If such a monopoly were to operate successfully, it was in his interest to have a servicable mill and a fair miller. Traditionally the suckeners have been portrayed as being oppressed by landowner and miller alike, and forced to pay exorbitant sums for badly executed grinding at inconveniently situated mills. True, multures did force them to pay more than the real cost for milling, but very high multure rates of $1/13$ th or $1/11$ th so often cited by later writers were not so common as were rates

of 1/16th or 1/24th⁷⁸. Furthermore, the widespread practice of offering outentown multure rates suggest that many paid much lower rates. Allowances should also be made for the inherently biased nature of the evidence available, notably Barony and Session Court records, which emphasise those cases in which abstractions were detected while ignoring those which went unnoticed. What is more, by paying a dry multure⁷⁹ to compensate the miller for loss of income, a suckener under thirlage of grana crescentia could sell his corn on the open market, or even take it to another mill to be ground at outentown rates. And for all the criticism of inconveniently sited mills, the establishment of thirls tended to minimise the distance from a mill in an age of chronically poor transport facilities, although there may have been cases where another mill was more accessible. Certainly the number of mills was much greater than could have been supported by a "free" clientel^e and when, during the century after 1730, a move away from grain monoculture and the development of more sophisticated technologies brought an end to thirlage, the number of working grain mills fell sharply.

Burgh Mills

Burgh mills operated in circumstances rather different from those of their rural counterparts: little grain was grown within the bounds of the thirl and most of that needed by bakers, brewers and other persons was brought in from outwith it. Invecta et illata, that

particular type of thirlage which developed in burghs, has already been referred to in a general context. In this section it will be examined in more detail.

As centres of population, burghs could be expected to yield much more substantial profits from the imposition of thirlage than could rural areas. Throughout the period the magistrates of royal and ecclesiastical burghs sought to turn this fact to some advantage, by obtaining control of those burgh mills which were not already theirs, creating or strengthening thirlage to them, and setting them in tack for cash rents.

Acquiring Mills

Mills came into the hands of burgh authorities through various agencies: in 1641 the burgh of Dundee was granted, by royal charter, the two Castle Mills plus a windmill in the burgh, as well as multures and sequels⁸⁰; in 1670 Jedburgh bought the East, Town and Abbey Mills of that town from Lord Lothian⁸¹, while in 1617 the town council of Edinburgh added Bonnington to its existing mills, paying Robert and George Logan 1230 Merks for it⁸². By imposing a 2d per pint duty on ale and beer, the same corporation was able, in 1722, to buy inter alia, Leith Mills⁸³. Linlithgow was granted its burgh mills by the Prioress of Manuel Convent in 1586 for a mere 20 Merks⁸⁴.

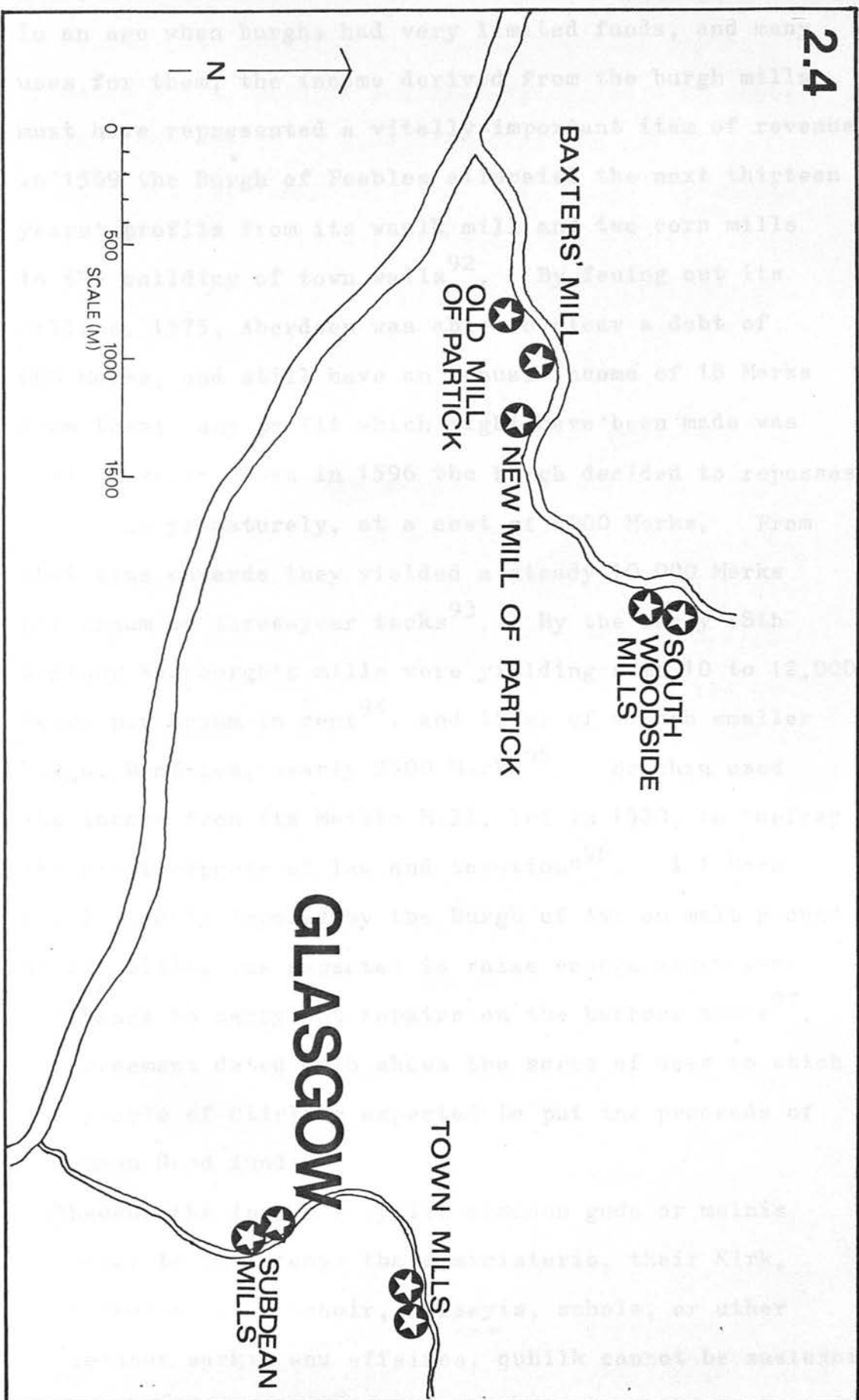
Establishing a Thirl

In burghs of Barony control of the mills usually rested with the feudal superior; multures were payable either to him or his tacksman, and it was by him, or his pre-

decessors, that the thirlage was established. In many ways, these burgh mills resembled those of rural areas. However, such thirlages did not necessarily exist in royal and ecclesiastical burghs, and when it came to acquiring a mill on the burgh's behalf, it was sometimes necessary to create a thirlage from scratch, as did Jedburgh in 1670⁸⁵. In 1576 the burgh council of Glasgow attempted to establish a thirl over the town, and to let the mills on a year by year basis⁸⁶. The town's common mill (figure 2.4) was rebuilt at a cost of £98 18s 10d Scots⁸⁷ and while these alterations were being made, another mill, which was to stay in the burgh's hands, was leased from Alexander Lyon⁸⁸. However, the scheme was looked upon with disfavour, and by 1581 it was being claimed that, on account of the mills' inadequacy, the thirlage should be abolished:

".....nane of the saidis mylnis at na seasoun of the yeir wilbe able to mak continewall and daylie service to this tounschip, being populus and haifing hourelie victuale of gritt quantitie to grind, and becaus the said mylnis are situat on burnis quhilk will stand the haill symmer seasoun dry without watter, nocht withstanding thair wer sufficiensie of watter yit ar thei nocht able to grind nor mak seruive to the haill inhabitantis of this toun."⁸⁹

Under such pressures, thirlage had to be abandoned, though the mills continued to be set in tack for a small sum⁹⁰; in 1608, the idea was resurrected, with a view to clearing the town's debts⁹¹.



Common Good

In an age when burghs had very limited funds, and many uses for them, the income derived from the burgh mills must have represented a vitally important item of revenue. In 1569 the Burgh of Peebles allocated the next thirteen years' profits from its waulk mill and two corn mills to the building of town walls⁹². By feuing out its mills c. 1575, Aberdeen was able to clear a debt of 600 Merks, and still have an annual income of 18 Merks from them; any profit which might have been made was lost, however, when in 1596 the burgh decided to repossess the mills prematurely, at a cost of 5000 Merks. From that time onwards they yielded a steady 10,000 Merks per annum on three-year tacks⁹³. By the early 18th century Edinburgh's mills were yielding some 10 to 12,000 Merks per annum in rent⁹⁴, and those of a much smaller burgh, Dumfries, nearly 2500 Merks⁹⁵. Brechin used the income from its Meikle Mill, let in 1580, to "defray the great expense of law and taxation"⁹⁶. A 1 Merk per boll duty imposed by the Burgh of Ayr on malt ground at its mills, was expected to raise enough money over ten years to carry out repairs on the harbour there⁹⁷. An agreement dated 1616 shows the sorts of uses to which the people of Stirling expected to put the proceeds of a Common Good fund:

"because the toun hes lytill commoun gude or meinis
ather to intertenye thair ministerie, thair Kirk,
tolbuyth brig, schoir, calseyis, schole, or uther
commoun warkis and effaires, quhilk cannot be susteinit

without the rents and commoditie of mylnes as utheris
tounes hes, thairfoir how soone the toun may have
occasioun to acqyre and gett mylnes able to serve
the toun, we.....sall consent and grant, with
the remanent inhabitantis of this burgh, to thirle
our selffis to the saidis mylnes for siclyik servyce
and deuteis paying as the burrowis of Lynlithgow or
Glasgow payis and gevis."⁹⁸

Malt Milling

If urban thirlages were to be effective, then the co-
operation of brewers and maltmen was essential, for while
their contribution was of only minor importance in most
rural areas, it was malt, as much as grain, which pro-
vided grist to a burgh's mills. Although Edinburgh's
mills (seven in 1573⁹⁹, twelve by 1599¹⁰⁰) relied partly
on the thirlage of the baxter's wheat, the abstraction
of malt was serious enough to cause "grete hurt" to the
common mills as early as 1556¹⁰¹, while by 1710 it could
be claimed that without the brewers, the town's mills
would not have been worth maintaining,¹⁰² a claim which
might have been made of most Scottish burghs, but espe-
cially of those such as Dundee¹⁰³ or Pittenweem¹⁰⁴, where
mills had been erected solely for the grinding of malt.

Glasgow's Burgh Mills

At Glasgow the same dependence was in evidence, for
although some grain was taken to the burgh's mills, the
baxters had had their own mill on the River Kelvin since
1578¹⁰⁵; when, in 1608, thirlage was re-imposed on
Glasgow they were specifically given exemption for wheat

and rye¹⁰⁶. The brewers on the other hand, had to agree to "brew na manir of malt in tyme cuming bot that malt that beis ground at the townis milnis". Those failing to comply were to pay double multure, plus an unlaw of £5 Scots¹⁰⁷.

With the revival of thirlage in Glasgow, it was necessary to ensure that the town had an adequate milling capacity, and with this in mind, the council leased the Old Mill of Partick from the Bishop of Glasgow¹⁰⁸, and Subdean Mills (comprising two water mills and a man mill), from the Laird of Minto¹⁰⁹. These, with Archibald Lyon's mill (alias New Mill), and the town's mill (Auldtoun Mill), were set in tack to George Anderson of Woodside, and James Lightbody, visitor of the maltmen and mealmen, for a period of five years, at a rent of 4400 Merks per annum¹¹⁰.

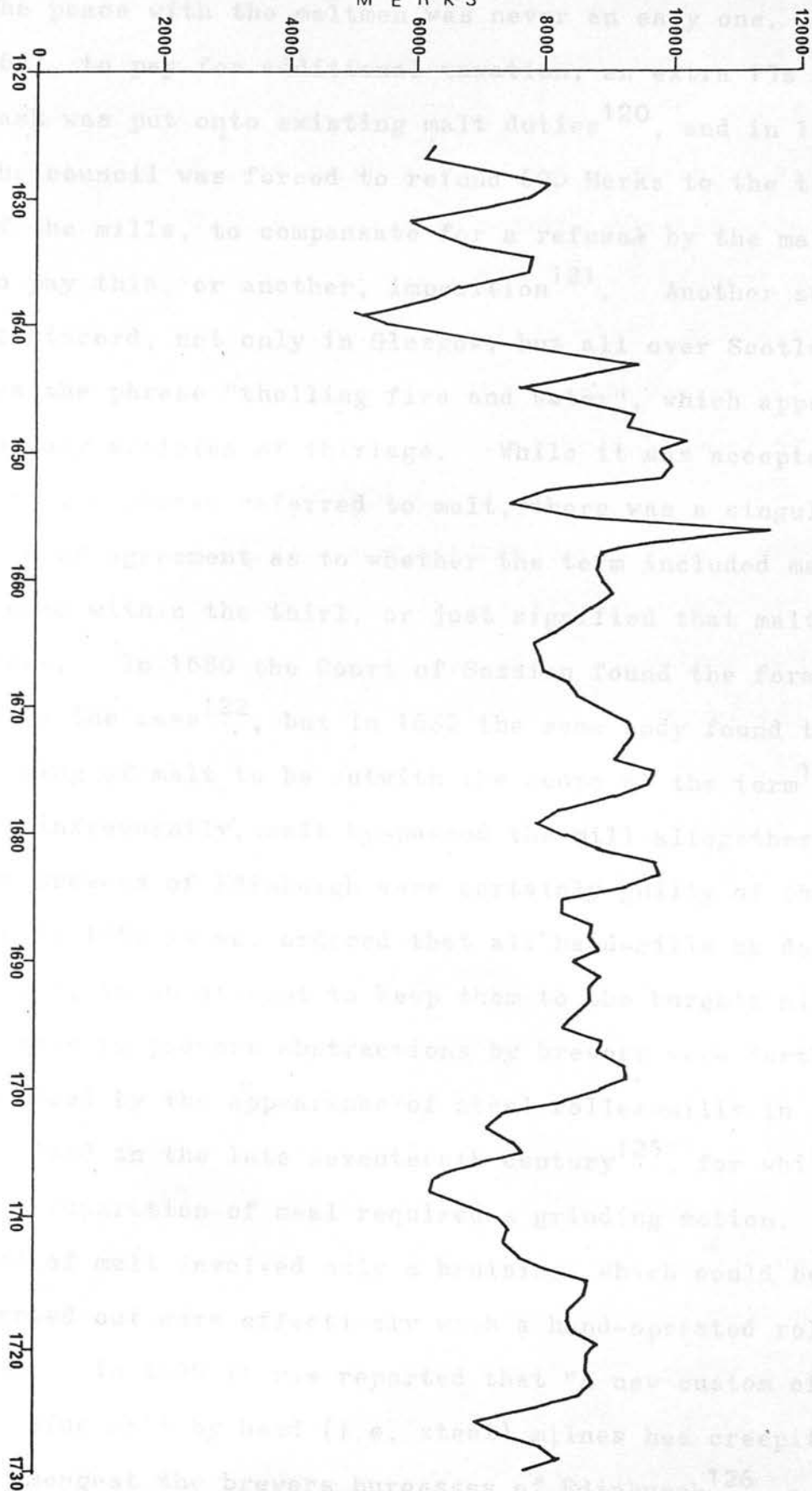
The re-establishment of thirlage had required the active co-operation of the guilds, but even assuming that it was forthcoming in the first place, it was short-lived. On the 2nd July 1608, less than two months after the mills had been let, there were complaints of malt being abstracted¹¹¹, and by the following September, in a desperate effort to uphold the value of its mills, the burgh was threatening that abstracters "sall never heireftir bruik office in kirk or commoun weill of this burgh", and that their freedoms would be "dischairgit and cryd doun". As a further measure, the unlaw of £5 Scots was quadrupled¹¹². These measures, while drastic, seem to have been effective, for at the expiry of

the mill lease in 1613, confidence in the strength of the astringency was such that the lease was roused for a further five-year term at a rent of 6466 Merks per annum¹¹³. Trouble threatened to erupt again in 1625, after one miller had given a customer's unground malt to his horse¹¹⁴, but the establishment of a bi-annual mill court, at which grievances could be heard, prevented further troubles. At the court's first sitting, the millers' duties were restated, and Tuesdays and Thursdays reserved for grinding malt¹¹⁵. From 1626 onwards, the mills were roused annually, yielding 6060 Merks in the first year, and continuing to bring in a revenue of between 5000 and 11550 Merks per annum throughout the rest of the period (figure 2.5). Only when plague visited the city¹¹⁶, or when exceptionally cold winters froze the mills tight¹¹⁷, was it found necessary to partially refund the rent. Over the years, the proceeds of letting the mills came to represent a considerable sum of money, which was applied to several major projects; by 1655, the council could claim that the townsfolk had been able to "repair thair kirkis, brigs, build thair tolbooth, commune caseys*, paying thair ministers stipends, and many mae commune workis, to the great guid, commodatioun, and decorment of the citie"¹¹⁸. Two years later, the unlaw for abstraction was raised from £20 to £100, presumably with a view to guaranteeing the continued prosperity of the burgh¹¹⁹.

* Streets - usually paved

2.5

M E R K S



The Introduction of Roller Mills

The peace with the maltmen was never an easy one. In 1667, to pay for additional taxation, an extra 15s per mask was put onto existing malt duties¹²⁰, and in 1689 the council was forced to refund 600 Merks to the tacksmen of the mills, to compensate for a refusal by the maltmen to pay this, or another, imposition¹²¹. Another source of discord, not only in Glasgow, but all over Scotland, was the phrase "tholling fire and water", which appeared in many articles of thirlage. While it was accepted that the phrase referred to malt, there was a singular lack of agreement as to whether the term included malt brewed within the thirl, or just signified that malted there. In 1680 the Court of Session found the former to be the case¹²², but in 1682 the same body found the brewing of malt to be outwith the scope of the term¹²³. Not infrequently, malt by-passed the mill altogether; the brewers of Edinburgh were certainly guilty of this. and in 1660 it was ordered that all hand-mills be destroyed, in an attempt to keep them to the burgh's mills¹²⁴. Efforts to prevent abstractions by brewers were further hampered by the appearance of steel roller-mills in Scotland in the late seventeenth century¹²⁵, for whilst the preparation of meal required a grinding motion. that of malt involved only a bruising, which could be carried out more effectively with a hand-operated roller mill. In 1699 it was reported that "a new custom of grinding malt by hand (i.e. steel) milnes hes creepit in amongst the brewers burgesses of Edinburgh¹²⁶. a

custom which continued despite repeated efforts to eliminate such mills¹²⁷. The confrontation with the brewers culminated in 1710 with a prolonged legal case in which the thirlage was found to stand¹²⁸, but for the Magistrates of Edinburgh, it was a hollow victory and in 1711 it was decided to commute the thirlage and multure of malt for 12d Scots per barrel of beer sold¹²⁹. In 1728, "those concerned with breweries" in Glasgow asked that the thirlage of malt be commuted, and that they be allowed to grind it with steel mills on their own premises¹³⁰.

Some counter-measures had already been taken: when, in 1725, a thirlage had been established over Port Glasgow, with a view to financing harbour repairs, the precaution had been taken of installing two steel mills in the port's mills¹³¹, while in 1727 the burgh of Glasgow bought a tack of Sir James Hamilton's mill at Newark for the "benefit" of its steel mills at Port Glasgow¹³².

Conclusion

During the course of the next hundred years or so, many a Scottish burgh was to add steel mills to its existing mills, but so great were the incentives for brewers to instal them in their own premises that such efforts did little to stem the tide of abstractions. Although burgh mills were to find other lucrative sources of income, it was malt which represented the most important input to urban grain mills in the period 1550 - 1730. By creating astrictions to include malt, burghs could let

Flour Mills

While the diet of the great bulk of Scotland's population continued to be based on oats and bere, rather than on wheat, it was unlikely that flour mills should be built anywhere other than the largest urban centres. None of the burgh mills of Glasgow had the requisite milling and boulting machinery, but the baxters are known to have had a wheat mill¹³⁴. At Edinburgh, wheat and rye were ground on the town's common mills and the implication is that here, as in other burghs known to have had incorporation of baxters, ordinary corn mills were used and boulting, if carried out at all, was performed by hand.

Pot Barley Mills

Something should be also be said of Scotland's first pot barley mill, built at Saltoun, East Lothian, in 1712, long before any other had been constructed, and therefore the only one to lie outwith the scope of the next section. On 17th April 1710, Andrew Fletcher of Saltoun entered into an agreement through his brother, Henry, with James Meikle, millwright at Wester Keith, under which Meikle was to visit Holland and investigate Dutch methods of making pot barley¹³⁵. Returning to Scotland, Meikle built for Fletcher a mill which incorporated an edge-running millstone, and Dutch fanners previously unknown in Scotland. During the 18th century, Saltoun barley mill, and the later bleachfield which bore its name, came to enjoy a widespread reputation.

- 1 : Roxburgh Mill and Ednam Mill both appear in charters dated 1128.
Chalmers, G. "Caledonia" 4 vols., London 1810 I 135
Burleigh, J. "Ednam and its Indwellers" Glasgow 1912
Mill at Crailing, Jedburgh and Selkirk are all referred to in charters of David I (1124-53) Chalmers, op.cit I 136, 997
- 2 : The earliest known reference to cloth fulling mills concerns one at Innerleithen during the time of David II (1329-71) Chalmers op.cit. I 935
- 3 : SRO GD110/740/1 SRO GD62/275
- 4 : SRO GD44/17/8
Mitchell, Sir A. (Ed.) "Macfarlane's Geographical Collections" SHS LI (1906), LII (1907), LIII (1908)
LI 105
- 5 : SBRS "Extracts from the Records of the Burgh of Edinburgh" IV, 1573-89, Edinburgh 1882. A new damhead for the Wester Mills of Edinburgh, built in 1584, used ashlar stone.
- 6 : SRO GD90/2/196
- 7 : McCall, H.B. "The History and Antiquities of the Parish of Mid-Calder" Edinburgh 1894. 40
- 8 : McGill, W. "Old Ross-shire and Scotland" Inverness 1909
- 9 : Morison, W.M. "Dictionary of Decisions of the Court of Session" 36 vols. Edinburgh 1811. XI 8895
- 10 : SRO GD121/408/1/38
- 11 : SRO GD44/19/10/H
- 12 : Morison, op.cit. XIV 15965

- 13 : Ibid. III 1818. In 1695 a new corn mill was built at Camserney, Perthshire, to which the suckeners of the Mill of Aberfeldy on the north side of the Tay became thirled. SRO GD 50/133/35
- 14 : Morison, op.cit. XI 8897-8
- 15 : SRO GD141/265
- 16 : Morison, op.cit. XXXV 15988
- 17 : Ibid. XXXV 15959, 15971, 15972, 15974, 15979
- 18 : For an example see Gunn, C.B. (Ed.) "Records of the Baron Court of Stitchill, 1655-1807" SHS L (1905) 22
- 19 : SRO GD188/3/4
- 20 : Barron, D.G. (Ed.) "The Court Book of the Barony of Urie in Kincardineshire, 1604-1747" SHS XII (1892) 90
Gunn, op.cit. 88, 112
Broun-Lindsay, Lady (Ed.) "The Barony Court of Colstoun: Extracts from its Records" TELA&FNS II (1930-31) 125-6
SRO GD18/695; SRO GD50/159; SRO GD245/7/4
- 21 : SRO GD50/159
- 22 : Barron, op.cit. 38
SRO GD50/159; SRO GD245/7/4
- 23 : Gunn, op.cit. 152
Barron, op.cit. 94-5
- 24 : SRO GD25/1/776; SRO GD50/159; SRO GD205/24/154
SRO GD225/1033
- 25 : Barron, op.cit. 94-5
Gunn, op.cit. 112
SRO GD245/7/4
- 26 : Morison, op.cit. XXXV 16968-9
- 27 : Broun-Lindsay, op.cit. 125-6
- 28 : SRO GD18/695

- 29 : SBRs "Extracts from the Records of the Burgh of Glasgow"
I, 1573-1642. Glasgow, 1876. 136. When the town's
mill on the Kelvin was inspected in 1589, it was found
to have a runner of only two inches thickness.
30 : SRO GD26/5/650. An appraisal of Shawsmill, Fife, taken
in 1693, includes a runner stone only one inch thick.
- 31 : Gunn, op.cit. 169-70
- 32 : SRO GD73/1/32(b)
- 33 : SRO GD10/1214; SRO GD86/726
- 34 : SRO GD109/3120; SRO GD157/1001
- 35 : SRO GD90/195-6; agreements on payment for the construction
of a "mill stool" and "mill wall" at Powmill (N0634557)
and a mill-dam at Kinnaird (N0632578), both in 1719
- 36 : SRO GD16/27/102; SRO GD26/2/1; SRO GD26/5/74;
SRO GD27/2075
- 37 : Cochran-Patrick, R.W., "Mediaeval Scotland" Glasgow
1892. 163-8
- 38 : SRO GD26/5/74
- 39 : Broun-Lindsay, op.cit. 147
- 40 : SRO GD26/5/87
- 41 : Ibid
- 42 : SRO GD26/5/74. For similar obligations see Gunn,
op.cit. 113
- 43 : SRO GD26/2/1
- 44 : SRO GD28/2075
- 45 : SRO GD137/3546
- 46 : SRO GD225/1033. 11 May 1727: The miller at the Upper
Mill of Rathven, Banff-shire, was set upon by one
Jean Wilson and her three sons and suffered the
humiliation of having to be rescued by his wife.

- 46 : SRO GD52/313; SRO GD62/266
- 47 : Smout, T.C. "A History of the Scottish People, 1560 - 1830" London 1969
- 48 : Morison, op.cit. XXXV 15975
- 49 : RSSRS 1st Series V.193 (1594); VI 423 (1602); VI 504 (1602); XI 51-2 (1616);
RSSRS 2nd Series II 596 (1628); III 14-15 (1629); V 640-1 (1634)
RSSRS 3rd Series I 399 (1662); II 650 (1669); III 133 (1669); VII 567 (1682); X 198 (1685)
- The same practice was extended to other types of mill with even more damaging results. RSSRS 3rd Series I 399 (1663)
- 50 : RSSRS 1st Series X 180 (1613)
- 51 : McGill, op.cit. Tain No. 420 (1678). When the Laird of Calrossie's Ross-shire mill was destroyed, its suckeners were faced with "all the toyell and trouble ...of going over the sands to the Milns of Morvie and Milntown".
- 52 : "Synod of Fife 1611-87" Abbotsford Club (1937) 29
- 53 : APS V 269 1640 c.15
- 54 : APS VII 262 1661 c.281
- For an example of similarly directed local legislation see SRO GD50/136/1 Vol 1, 11/12 July 1660
- 55 : Morison, op.cit. XXXV 15969
- 56 : SRO GD137/3546 (1631) (Balmerino, Fife)
SRO GD50/136/1 (1683) (Menzies, Perthshire)
SRO GD25/6/233a (1678) (Maybole, Ayrshire)
SRO GD26/2/1 (1666) (Monymail, Fife) A limited form of exemption.

- 57 : SRO GD25/6/233a The mill in question was Deansmill.
- 58 : SRO GD188/3/4
- 59 : SRO GD44/51/747; SRO GD45/18/385; SRO GD52/250;
SRO GD52/387; SRO GD124/17/175
- 60 : SRO GD25/6/39; SRO GD25/9/47; SRO GD25/9/76;
SRO GD109/2973, 3120, 3276, 3388, 3616
- 61 : SRO GD45/18/177, 385, 1497; SRO GD45/21/6;
SRO GD124/17/175; SRO GD188/3/4; SRO GD248/1384
- 62 : SRO GD44/51/747; SRO GD52/250, 387; SRO GD121/224/15
- 63 : SRO GD1/447/26; SRO GD16/28/307; SRO GD44/51/747;
SRO GD45/18/1497; SRO GD45/20/102; SRO GD52/387
SRO GD121/224/33
- 64 : SRO GD52/387
- 65 : SRO GD52/387; SRO RH15/25/93
- 66 : SRO GD18/734, 736; SRO GD28/2075; SRO GD52/250, 387;
SRO GD110/840; SRO GD121/223/44; SRO GD157/990, 1001;
SRO GD203/11/4; SRO GD237/202
- 67 : SRO GD128/47/8; SRO RH15/25/93
- 68 : SRO GD121/224/15
- 69 : RMSRS V.754 (1584)
- 70 : SRO GD26/5/123; SRO GD121/224/15; SRO GD203/11/44
- 71 : SRO GD1/413/12 Garvald p.33
- 72 : SRO GD26/5/119, 123
- 73 : SRO GD26/5/84, 86, 93, 107, 147, 148; SRO GD28/2161
- 74 : SRO GD1/447/26; SRO GD16/28/307; SRO GD121/224/15;
SRO GD124/17/175
- 75 : SRO GD121/224/15
- 76 : SRO GD121/224/15
- 77 : SRO GD157/990

- 78 : Of the thirty mills for which multure rates were
available four had rates of 1/25th, nine of 1/24th,
two of 1/21st, two of 1/20th, one of 1/17th, six of
1/16th, and six of 1/13th. Sources - various.
- 79 : See Appendix A
- 80 : SRO GD205/2 (Cond.2)
- 81 : Bennett, R. & Elton, J. "The History of Corn Milling"
2 vols. Liverpool, 1898-9 and 4 vols. New York, N.D.II 218
- 82 : Irons, J.C. "Leith and its Antiquities" 2 vols. Edinburgh
N.D. II 98
- 83 : Ibid. II 151-2
- 84 : OSA XIV 557 Linlithgow, West Lothian
- 85 : Bennett & Elton, op.cit. IV 214
- 86 : SBRs Glasgow I 56
- 87 : Ibid. I 463
- 88 : Ibid. I 57
- 89 : Ibid. I 86-7
- 90 : Ibid. I 136
- 91 : Ibid. I 277
- 92 : SBRs "Charters and Documents Relating to the Burgh
of Peebles, 1165-1710" Edinburgh 1872
- 93 : Kennedy, W. "Annals of Aberdeen" 2 vols. London 1818 I 410
- 94 : Morison, op.cit. 8899-8901
- 95 : McDowall, W. "History of Dumfries" Edinburgh 1867 544-5
- 96 : Black, D.D. "The History of Brechin to 1864" 2nd
Edition. Edinburgh 1867 45
- 97 : APS IX 456
- 98 : SBRs "Extracts from the Records of the Royal Burgh
of Stirling 1519-1666" Glasgow, 1887 143

- 99 : SBRS "Extracts from the Records of the Burgh of
Edinburgh" II 1528-1557 Edinburgh 1871 6
- 100 : SBRS Edinburgh V 1589-1603 258
- 101 : SBRS Edinburgh II 233
- 102 : Morison, op.cit. XI 8899-8901
- 103 : RMSRS XI 883 (1666)
- 104 : SRO GD62/263
- 105 : Cleland, J. "Annals of Glasgow" 2 vols. Glasgow 1816
II 512-3
- 106 : SBRS Glasgow I 278
- 107 : Ibid. I 280-1
- 108 : Ibid. I 278
- 109 : Ibid. I 279
- 110 : Ibid. I 280. This sum included the "ladles" or market dues.
- 111 : Ibid. I 284-5
- 112 : Ibid. I 289
- 113 : Ibid. I 337
- 114 : SBRS "Extracts from the Records of the Burgh of Glasgow"
II 1630-1662 Glasgow 1881 562-3
- 115 : Ibid. 564
- 116 : Ibid. II 127 (1647); 371 (1657)
- 117 : Ibid. II 27 (1635)
- 118 : Ibid. II 309
- 119 : Ibid. 360
- 120 : SBRS "Extracts from the Records of the Burgh of Glasgow"
III 1663-1690 Glasgow 1905 90
- 121 : Ibid. III 421-2
- 122 : Morison, op.cit. XXXV 15984
- 123 : Ibid. XXXV 15987
- 124 : Ibid. XI 8903

- 125 : SRO RH15/102/1 In 1694 one was bought in London for the corn mill at Newmills Manufactory, East Lothian.
- 126 : SBRs "Extracts from the Records of the Burgh of Edinburgh" XII 1689-1701 Edinburgh 1962 247
- 127 : Ibid. XII 247, 279
- 128 : Morison, op.cit. XI 8899-8901
- 129 : SBRs "Extracts from the Records of the Burgh of Edinburgh" XIII 1701-18 Edinburgh 1967 212
- 130 : SBRs "Extracts from the Records of the Burgh of Glasgow" V 1718-38 Glasgow 1909 266. For a contemporary rural example of steel mills see SRO GD6/1028
- 131 : SBRs Glasgow IV 208-10, 222
- 132 : Ibid. 290
- 133 : SBRs "Extracts from the Records of the Burgh of Edinburgh" X 1665-80 Edinburgh 1950. xxxiii
- 134 : RSSRS 3rd Series, I 1661-4
- 135 : East Lothian County Council "East Lothian Water Mills" Haddington 1970. 12. The contract is reproduced on the same page.

CHAPTER THREE

WATER POWER IN THE TEXTILE INDUSTRY

From Mediaeval times onwards, the growth, manufacture and export of wool assumed an important place in the economy of Scotland, and by the late 16th century, textile production as a whole had become, by Scottish standards, "ane industry of considerable stature"¹. Wool, being a plentiful natural resource, and a ready source of foreign revenue, was exported raw throughout the period: in a table of Scottish exports for the period 1611 - 1614 woolfells*, valued at £143,000 Scots represented the largest single item, while wool, valued at £52,000 Scots ranked fifth out of seventeen commodities with a total value of £736,000 Scots².

There was, however, an awareness that by exporting wool as cloth Scotland could obtain more foreign revenue than by exporting only raw wool; as Sir Thomas Craig pointed out in 1605:

"In future our people must pay very particular attention to the manufacture of cloth, for thence will proceed our ability to import wines, merchandise, and those things on which men set store. Otherwise, we shall find it hard to raise the money to pay for our imports"³.

What Sir Thomas Craig's appeal fails to bring out is that Scotland already had a significant domestic wool manufacture which provided for the needs of the majority of Scots and which had been using water power in one process for several centuries.

* Full skins of wool



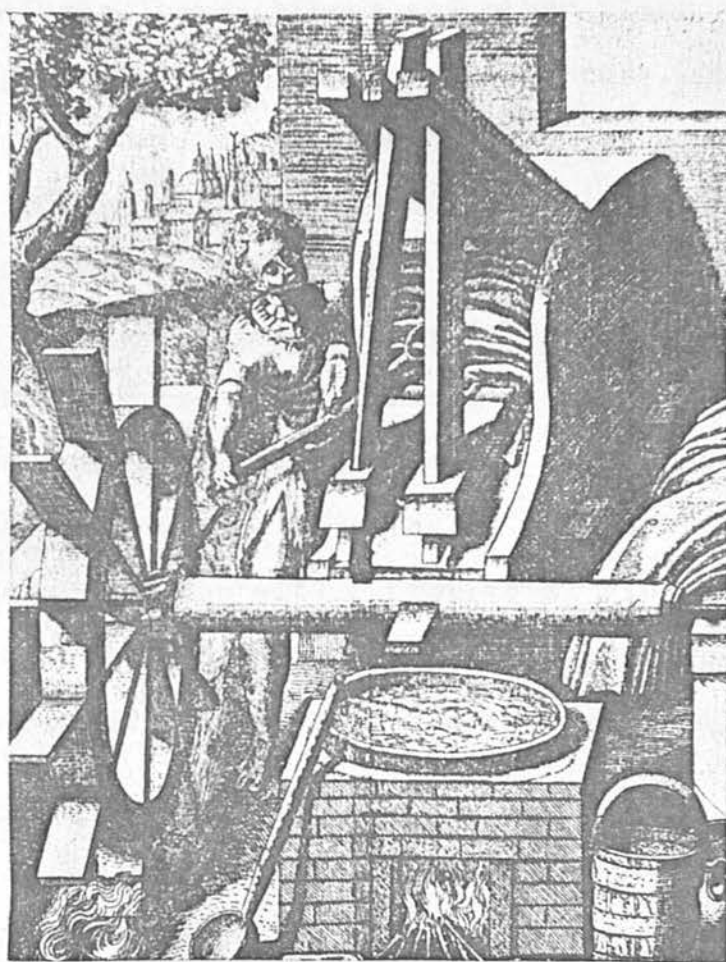
Origins, Introduction and Technology of Fulling

From its earliest application to the textile industry in the 12th century⁴, water power was confined to fulling, a finishing process whereby warp and weft fibres were matted together. The machinery employed consisted of a lying shaft, fitted with cams, which alternately depressed and released a hinged arm, at the far end of which was fixed a wooden block which rose and fell in a trough of water (figure 3.1). The movement of the block on a piece of cloth immersed in the trough imitated the action of feet, the use of which had given the name walking or waulking to the fulling process. When the process was mechanised, the name stuck, and in Scotland fulling mills were known as waulk mills. Appendix B gives details of the construction of a waulk mill at Penicuik, Midlothian.

Although teasing, carding, spinning and weaving continued to be performed by hand, the application of water power to the laborious process of fulling was sufficiently important a breakthrough to be considered as an "Industrial Revolution in its own right"⁵. The fulling mill soon found its way to Scotland, the earliest known being one mentioned during the reign of David II (1329-1371) at Innerleithen, Peeblesshire⁶.

A waulk mill could be readily built using resources gathered from a small area. The construction of a particularly fine mill at Gifford, East Lothian, exemplifies this well. Sandstone, cut from quarries at Garvald and Quarryford Mill, was carried by cart to the site:

3.1



two pairs of men carted over a hundred loads of lime which, together with the stone, was used by two masons (both from Gifford) to build the mill. Of the timber required, nine oaks were cut in the Cersell Wood, one in the Deer Park, and two pieces taken from the wood yard; two elms were cut in the briken gett and one birch tree from the end of Lamintien's Walk. The eight thousand nails used were provided by the local smith. who also made locks, hinges and other items of ironwork. Two wrights, working at different periods, put in one hundred and three days' work, at 20d per day. They and their five assistants installed floor boards, wooden beams, seventeen windows, six doors and a staircase. A gang of ten day-labourers helped the craftsmen, excavated lades, and carried the one hundred and forty-seven loads of stone needed for the damhead. The waulk-miller himself had lived in the next parish and took part in the construction of the mill. The total expenditure of £115 18s. 9d represents a sum well above what might be laid out on building a more typical waulk mill⁷.

Distribution

According to Gulvin, fulling mills were still scarce in the 17th century, only a few Lowland centres having one⁸. Unfortunately, no complete list exists, but research has revealed that they were by no means scarce, there being at least three hundred fulling mills in Scotland, from Orkney to Galloway and from Berwickshire to Islay (figure 3.2). As one might expect, their distribution coincides with those areas most associated with woollen cloth

3.2



manufacture during the period. Aberdeenshire, Strathmore, Perth - Dundee, the Fife Leven, the Stirling area, North Ayrshire, Galloway, Edinburgh, the Esk Valley, Haddington and the Borders all show concentrations of mills; Galashiels and Huntingtower, Perth, each had three fulling mills⁹. Also apparent, however, is the widespread dispersion of mills throughout much of Lowland Scotland, for besides the cloth which found its way onto the market, great quantities were woven for domestic use wherever wool could be obtained.

Operation

For a landlord with the capital to spare, the establishment of a waulk mill could provide a steady income in the form of rent, generally in cash rather than kind. Sums varied from £4 Scots (plus twelve capons) in 16th century Aberdeenshire, to £60 Scots in 18th century Wigtownshire¹⁰. A survey of certain parishes, carried out in 1626, cites the absence of waulk mills as one reason for the low valuation of Newton parish, Midlothian, and their presence as the reason for the augmented value of Logie parish, Stirlingshire¹¹.

Although no multure could be exacted, a thirlage similar to that of corn could be established over the tenants of the mill owner. At Stitchill, Roxburghshire, in 1698, all those living within the barony were thirled to Stitchill waulk mill during their residency, with a £5 Scots fine for each abstraction. In exchange for this, the suckeners were offered safeguards similar to those which applied to grain mills:

"...if any...persons have ground of complaint for insufficient work, either litting or waking, or for ther wakers detayning ther cloath longer than the dew reasonable tym, the waker shall be obleidged to repair the complainer in all damage that they have therby suffered. And lykewyse shall be fynned in the soum of 5lib Scots for each failzie, the one halfe to be given to the complainer besyd his reparation of damage for said. Lykewyse declairing that if it can be sufficiently instructed by any of the saids persons that the waker refused ther work at reasonable pryce (which is heirby declared to be the ordinar pryce of other workmen in the country) they shall have liberty to imply uther and cary the work to uther mylnes. The waker is ordayned to go through the parioch and cary away the cloath and bring it back again."¹²

Besides the rural waulk mills, there were those associated with burgh crafts, such as weavers, bonnetmakers and skimmers*. In Edinburgh, an agreement (later found to be unlawful) was made between the deacons of the bonnet-makers and the walkers of Edinburgh, involving mills at Roslin, Colinton, Silver Mills, Bells Mill, Wester Woodmill, Baldony Mill and elsewhere¹³. Between Woodhall, in Colinton parish, and the sea, there were at least ten waulk mills operating on the Water of Leith during the period 1550 - 1730, all largely dependent upon work supplied by Edinburgh guilds. In smaller burghs, one or other of the guilds often owned, or at least rented,

* Skimmers used waulk mills to soften hides.

a mill of their own: the bonnetmakers of Dundee had their own mill at Balmossie Mill¹⁴ while at Kilmarnock the bonnetmakers had a waulk mill which still bore their name in the 19th century¹⁵.

Although new mills might be built and others converted from corn mills there was nothing inherently new in the organisation of either rural or urban waulk mills: seldom, if ever, were they anything other than isolated units in the manufacturing process, taking in cloth which had been woven elsewhere, and spun in yet another place. In the mid-17th century however, a new type of unit began to appear, in which the various stages in manufacture were spatially integrated. These new "protofactories", if one might call them that, also departed from tradition in the type of cloth produced for, instead of the usual coarse cloth, they were primarily concerned with producing high quality products.

For some time the Government had sought to improve the woollen industry. In 1582, legislation was passed enabling a group of Flemings to come to Scotland to instruct apprentices and a second group was later brought over for similar purposes. In both cases, little benefit was derived, although in 1609 the few members of the latter group still resident in Scotland were said to be giving "grite licht and knowledg to the country-people"¹⁶. A Standing Committee for Manufactures, set up in 1623, failed to make any lasting impression, and it was not until the passing of Acts aimed at helping the fine

woollen sector, in 1641 and 1645, that even limited success was achieved. Under the Acts manufacturers were permitted to import, duty-free, wool, oil and dye-stuffs; the cloth made was also free of all duties and the manufacturers and their workmen were granted exemption from military service¹⁷. As a result of the two Acts, woollen manufactories were set up at Edinburgh (Bonnington) Ayr and Newmills, near Haddington. Those at Bonnington and Newmills were said to have had some success, but the latter failed to survive General Monk's occupation of Haddington in 1651¹⁸. The Newmills operation definitely included a fulling mill: in the early 17th century a fulling mill there had been converted into two grain mills but by 1649 one had been converted back again, probably to serve the manufactory¹⁹.

The Glasgow Manufactory

Not so well-known, but probably better documented, was a manufactory set up in Glasgow in 1650. On 2nd March of that year, the burgh council decided to engage Simon Pickersgill, an English clothier, to build and manage a cloth manufactory²⁰; for his services, Pickersgill was to receive £45 Sterling per annum, an indication of the importance attached to his skills²¹. Events moved with a speed uncharacteristic of 17th century Scotland: by the end of March, Simon Pickersgill and one John Carse had been promised 40s to cover their expenses in visiting waulk mills in the "east country" (presumably the Edinburgh area), and by the end of April sufficient progress had been made for work to begin on cutting the lade to serve

a new waulk mill at Partick²². The design of the mill was probably based, therefore, on the best to be found in Scotland. For their looms they looked further afield and on 4th May 1650, Peter and John Johnstoun were instructed to go to Holland where they were to buy £500 worth of equipment for the manufactory²³.

Within the year of Pickersgill being taken on, the manufactory was well established, buying its own wool and dyestuffs from abroad, spinning yarn, weaving cloth, fulling and dyeing it. Without hesitation, the council engaged Pickersgill for a second year, at a slightly augmented salary²⁴. Revolutionary as this degree of integration may have been for its time, the next step taken was even more so. In May 1651, the sale of cloth and the profit accruing therefrom, was brought under the control of the manufactory. Edward Robiesoun, the man responsible for marketing, was to collect dressed (i.e. fulled) cloth from the manufactory, sell it and return the proceeds for re-investment in raw materials such as wool and dyestuffs. Prior to being sold, each piece was to be inspected and valued²⁵.

Whether on account of poor results, or just lack of interest, the burgh council's direct involvement with their ambitious and far-sighted project was short-lived. In July 1652, the manufactory was set in tack to Pickersgill²⁶, and thereafter no more is heard of the manufactory, or of its waulk mill until 1660, by which time the original integrated organisation had ceased to exist. The weavers offered to take the "hous of manufactorie" for a period

of seven years, at £60 Scots per annum, while the waulk mill was leased to the liltsters, for the same duration, at £100 Scots per annum; in effect, control had reverted to the guilds and in that respect the mill had come to be no different from any other urban waulk mill. Although the liltsters' tack incorporated the provision that they should vacate the mill, were it needed for any other purpose²⁷, they continued in possession for five years, took a second term in 1665 and were offered a third in 1671²⁸. Despite repairs in 1689, the mill had fallen into ruin by 1695, and the tacksman had sunk deep into debt. In the latter year, a liltster, Thomas Brown, took over the mill with promises to rebuild it; the following year he obtained a nineteen-year tack of the restored mill at 100 Merks (£66 13s 8d Scots) per annum, and was offered a further eleven years on the expiry of the first term²⁹. By 1717, the mill was once again in ruins, with the water wheel broken to pieces and the watercourse running through the mill itself³⁰. Once again the mill was restored and although flax-scutching equipment was installed in 1735 (see p. 258) it was only on condition that part of the mill be always kept as a waulk mill³¹. As for Simon Pickersgill, he seems to have held his interest in the manufactory long after the weavers had taken over and not until 1675 was his imminent departure noted. For all the capital invested and effort expended in establishing the manufacture of fine woollen cloth, very little was achieved and even when, in 1661, the Act of 1641 was re-enacted, it was to little effect in the

absence of a well-protected home market³³. Not until 1681, with the passing of the Act for Encouraging Trade and Manufactures, was a positive move made towards providing such protection.

Besides banning the importation and wearing of certain luxury items, the Act prohibited the importation of many different types of fine cloth. Foreigners possessed of either capital or technical skills were to receive naturalisation on setting up manufactures of cloth, linen, stockings or soap and on teaching the trade to Scots. Any raw materials required for a manufactory qualifying under the Act were to be admitted free of custom and all other public duties in perpetuity. Any manufactured products exported were to be exempted from duties for a period of nineteen years. The capital invested was declared not to be subject to public or local taxes; soldiers were not to be quartered in Manufactories and workers were to have seven years' exemption from military service. Lastly, the Act prohibited the export of home produced raw materials such as lint or yarn³⁴.

The favourable industrial climate created by the Act led to the establishment of fine-cloth manufactories in Edinburgh, Glasgow, Musselburgh and at Gordons Mills, (Aberdeen), Harcarse (Berwickshire) and Gardin (Angus)³⁵, but the first, and the most successful, was the resuscitated Newmills manufactory, near Haddington.

Newmills Manufactory

The buildings and lands of the earlier manufactory had under which cloth for this purpose was imported from

come into the hands of Sir James Stampfield and it was he, with Robert Blackwood, a prominent Edinburgh merchant, who held most of the shares in the Newmills company of 1681. Stampfield agreed to let to the company "that great manufactory stone house on the south side of the village of Newmylnes, being 101 foot in length, 21 foot in breadth within the walls and three storie high". dimensions not untypical of the cotton mills of a hundred years later (p. 481); the waulk mill was also included in the lease³⁶. With favourable government policies and the prestige of royal patronage there was little difficulty in raising capital; indeed, in its early years finance was the least of the company's problems. Initially, there was difficulty in recruiting weavers from England and when, in October 1681, production did start, it was with only two looms which produced not fine but coarse cloth. For some time after the prohibition of fine cloth imports, demand for fine woollen cloth outstripped production at Newmills. By 1683, the number of looms had increased to twenty-seven and, this not being sufficient to meet demand, a further ten looms were ordered³⁷. The company now felt in a position to submit tenders for the military uniforms which the Privy Council had recently approved but in the event it was found that they could provide only part of the cloth needed and this at a price well above that of English cloth. In the interests of economy, but much to the company's disappointment, a special licence was granted under which cloth for this purpose was imported from

England. The granting of licences ceased in 1685, but despite this, and the granting to the company of further privileges, complaints about the importation of fine cloth and the export of wool were still being made in 1696. Only with the passing of a further Act in 1701 were these imports and exports banned and even then the legislation proved to be ineffectual; in 1704 the full resumption of wool exports received official consent³⁸. For all its difficulties, the company managed to survive in one form or another for a period of thirty years. Employment had been found for 700 people at a time when the provision of work was seen as being of paramount importance; to accommodate workers a "considerable village" had been built³⁹. Besides a fulling mill, which Defoe later described as "very good"⁴⁰, the company installed a gig-mill for raising the surface of cloth⁴¹. Such mills first appeared in Europe during the late 15th century, and had been used in England since at least 1640. That at Newmills was imported from England. As for frizzing mills, which by a circular rubbing motion gave the cloth a granular effect, none are recorded at Newmills, though two had been installed at Restalrig paper mill by 1690. In 1673 the owner of the paper mill, James Hamilton of Little Earnock, received ratification from Parliament of the privileges of a manufactory for freizing cloth⁴².

The application of power to fulling and probably to cloth raising, helped to remove a major bottle-neck in production, but a continued dependence upon skilled manual labour for every other process ensured that production remained inflexible and incapable of fulfilling large orders or benefitting from any potential economies of scale. In this vital respect the manufactories of the late 17th century differed from the mechanised textile mills of the late 18th century. Furthermore, the Newmills company had to pay higher wages to attract English workers; according to Gulvin, wage rates for immigrant workers was fifty per cent higher than those paid in England and nearly twice those paid to Scots. Fine wool, unobtainable from Scottish sources, had to be imported from England and Spain and to buy these, the Scots had to bid against the better established Dutch and English industries.

The Scottish fine cloth industry had never achieved a state of good health. Government policy had failed to help and even before 1707 the industry was mortally ill; the Union did little more than to administer the death-blow, most of the manufactories being given up soon after. By 1711 preparations were being made to wind up the Newmills works and on 20th March 1713, the machinery was sold off⁴³.

Whatever the benefits of the Union may have been for other industries, there were few on the surface for the Scottish woollen industry. Exports of raw wool were banned and Scottish manufacturers were exposed to open competition from England.

But however little hope there was for the fine woollen industry, the traditional manufacture of coarse woollens survived unscathed: low quality also meant low price and, for the great majority of Scots, clothing needs continued to be met by the household manufacture of wool from local sheep, employing the services of nearby listers, waulkers and custom weavers. The home market continued to offer an outlet for surplus production, while markets for cheap cloth in the English colonies, now legitimate customers for Scottish traders, helped to compensate for any lost in Europe⁴⁴. When, eventually, power was applied to other processes in the manufacture of wool, it was, significantly, not large joint-stock companies but the owners and lessees of waulk mills who were able to seize the opportunity and put production onto a true factory basis.

REFERENCESCHAPTER THREE

- 1 : Lythe, S.G.E. "The Economy of Scotland in its European Setting 1550-1625" Edinburgh 1960. 39
- 2 : Pryde, G.S. "Scotland from 1603 to the Present Day" Edinburgh 1962. 28
- 3 : Quoted in Pryde, op.cit. 28
- 4 : See Scott, E.K. "Early Cloth Fulling and its Machinery" TNS XII 1931-2 30-52
- 5 : Carus-Wilson, "An Industrial Revolution in the Thirteenth Century" EcHR XI-XII (1941-3)
- 6 : Chalmers, G. "Caledonia" 4 vols London 1810 II.935
- 7 : NLS Acc. 4862 Box 46 f 1
- 8 : Gulvin, C. "The Tweedmakers" Newton Abbot 1973 20
- 9 : RMSRS X 139 (1653); RMSRS IX.997 (1640)
- 10 : RMSRS VI 1902 (1607)
- 11 : "Reports on the State of Certain Parishes in Scotland 1627" Maitland Club XXXIV Edinburgh 1835
- 12 : Gunn, C.B. (Ed.) "Records of the Baron Court of Stitchill, 1655-1807" SHS L (1905) 139
- 13 : RMSRS 1st Series X 589 (1616)
- 14 : SRO GD45/18/444
- 15 : OS 6"/mile 1st edition Ayrshire (1856)(GR NS437392)
- 16 : Gulvin, op.cit. 22-23
- 17 : Ibid. 23
- 18 : Scott, W.R. "Joint Stock Companies to 1700" 3 vols Cambridge 1910-12 III 138 et.seq.
- 19 : RMSRS VII 1595 (1617); RMSRS VIII 1547 (1630); RMSRS IX 2039 (1649): The manufactory had certainly started by 1644, in which year Sir Adam Hepburn of Humble and Sir James Riddell, an Edinburgh merchant, took in William Sykes, an English clothier, as partner.

- 20 : SBRS Glasgow II 185
- 21 : Ibid. 185
- 22 : Ibid. 186. An earlier waulk mill at Partick is referred
to in RMSRS V 1406 (1587)
- 23 : SBRS Glasgow II 207
- 24 : Ibid. 199, 200
- 25 : Ibid. 207
- 26 : Ibid. 234
- 27 : Ibid. 435
- 28 : SBRS Glasgow III 64, 158
- 29 : SBRS Glasgow IV 161, 178, 204, 534
- 30 : Ibid. 618
- 31 : SBRS Glasgow V 434
- 32 : SBRS Glasgow III 199
- 33 : APS VII 261-2
- 34 : Scott, W.R. (Ed.) "New Mills Cloth Manufactory, 1681-
1703" SHS XLVI (1905) xxxvii - xxxviii
APS VIII 348-9
- 35 : Gulvin, op.cit. 24
- 36 : Scott, op.cit. (1905) 1vi
- 37 : Ibid. 1xiii
- 38 : Gulvin, op.cit. 25-6
- 39 : Scott, op.cit. (1905) 1xv
Mitchell, Sir A. (Ed.) "Macfarlane's Geographical
Collections" SHS LI (1906) LII (1907) LIII (1908). LIII
- 40 : Defoe, D. "A Tour thro' the Whole Island of Great Britain"
2 vols London 1727 II 701
- 41 : SRO RH15/102/1
- 42 : RSSRS 3rd Series XV 1690
APS IX 340 1693 c.83

43 : Scott, op.cit. (1905) 1xxxiv

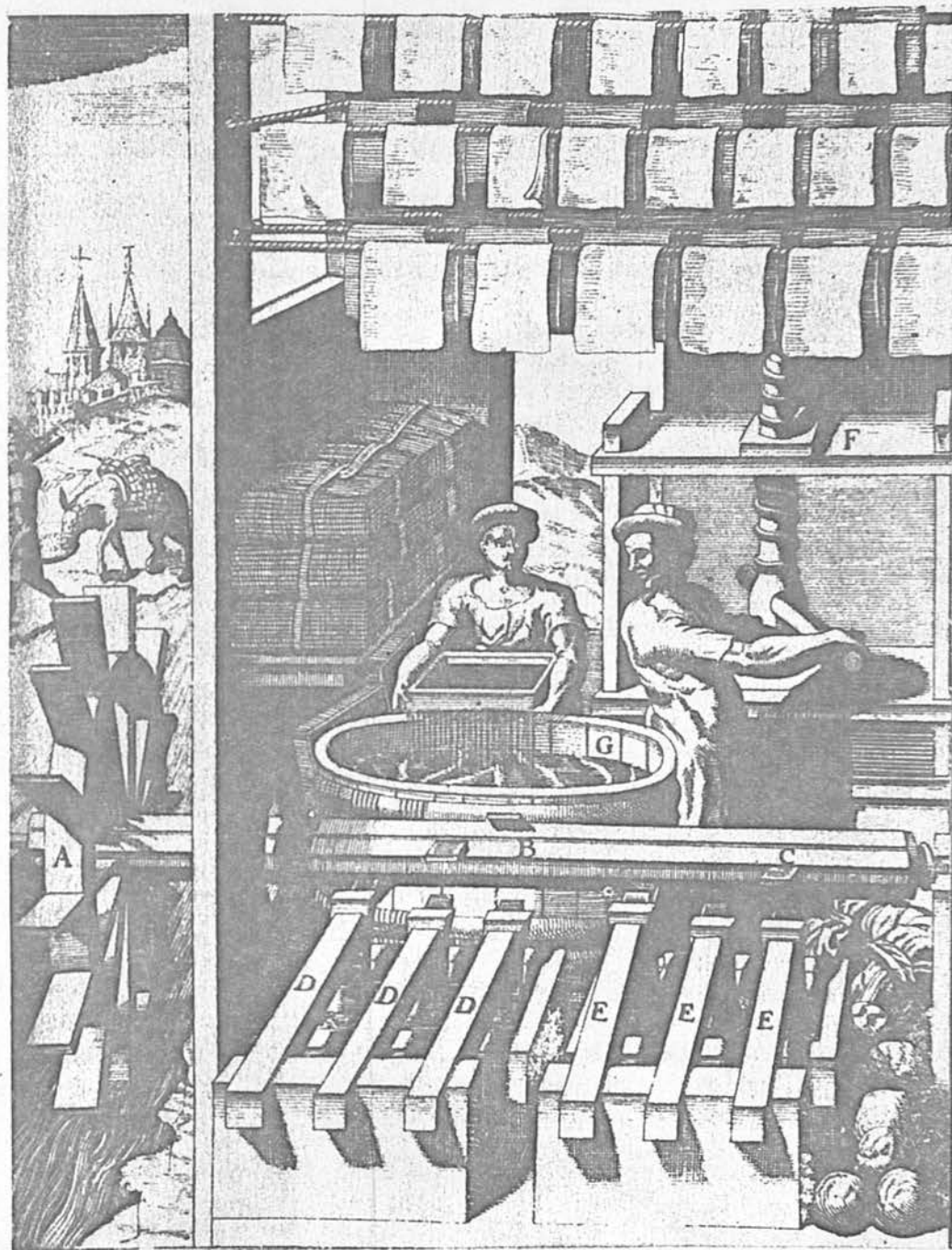
44 : Gulvin, C. "The Union and the Scottish Woollen Industry 1707-1760" SHR L (1971)

Origins and Introduction

The art of paper-making seems to have originated in China, and to have reached Europe via Spain, through the agency of the Arabs. As early as the 12th century, the water-laid method had been applied to the industry at Istava in Spain, where it was often used to soften and pulp rags. The first development from the rolling mill; during the course of the next few centuries paper-making incorporated the use of water-powered stamping-mills (Figure 4.1). These were established in France, Switzerland, Germany and the Low Countries, the processes involved being the subject of much secrecy. About the year 1493, one John Spilbergh brought to England a first paper mill. The first paper mills were founded in Scotland in 1581, with the establishment of a mill at Glasgow by a German, Hans Spilbergh, and a second at Aberdeen in 1582. Only five years later, in 1587, a third mill was founded at Perth. In 1588 James VI had a paper mill set up at Edinburgh, and a monopoly to "fix the price of paper" was granted. In 1590, a fourth paper mill was founded at Glasgow. In 1591, the technically advanced German mill, by the late 16th century, reaching opportunities to exploit their knowledge in countries where the art was new. Furthermore, the favourable attitude of the crown towards industrial development provided an incentive for such people to settle in Scotland.

Origins and Introduction

The art of paper-making seems to have originated in China, and to have reached Europe via Spain, through the agency of the Arabs. As early as the 12th century, the stamping-mill had been applied to the industry at Xatava in Spain¹, where it was often used to soften and pulp rags, a natural development from the fulling mill; during the course of the next few centuries paper-making, incorporating the use of water-powered stamping-mills (figure 4.1) became well established in France, Switzerland, Germany and the Low Countries, the processes involved being the object of much secrecy. About the year 1495, one John Tate built England's first paper mill in Hertfordshire. Two additional mills were founded in the 1550's, but not until 1585, with the establishment of a mill at Dartford by a German, Hans Spielman, did a commercially successful mill appear². Only five years later, in 1590, Scotland had her first paper mill. In 1588 James IV had granted privileges, then a monopoly, to "Pietter Gryther and Michaell Kysar, almanis paper makeris". In paper, as in metallurgy, the technically advanced Germans were, by the late 16th century, seeking opportunities to exploit their knowledge in countries other than their own. Furthermore, the favourable attitude of the crown towards industrial development offered an incentive for such people to settle in Scotland.



Dalry Paper Mill

By 1590, a paper-mill with a nine-year monopoly was in operation at the Wester Mill of Dalry, on the Water of Leith near Edinburgh³. By a contract of 3rd May 1594 the Russells, owners of Dalry Mills, agreed to provide further accommodation by raising the mill walls by eight feet and installing a loft for paper drying in the space thus made available; Mungo Russell and his son Gideon, had taken a share in the enterprise, which by this time was apparently thriving⁴. In exchange for an eleven year tack, Michael Keysar and another German, John Seillar, were to pay £200 Scots per annum, and to undertake to instruct apprentices as chosen by Gideon Russell⁵. Any suggestion that this might have been a public-spirited move to disseminate this useful knowledge is contradicted by another clause, which prohibited the Germans from giving assistance in the building of other paper mills.

The mill is mentioned in 1605, but in the absence of any subsequent references, both Waterston and Thomson were led to postulate that the mill was given up, and that not until 1673 was paper making at Dalry resumed. A paper mill at Dalry appears in the Register of the Great Seal in 1642, but the document concerned is apparently based on that of 1605⁶. What is certain is that in 1673 a mill at Dalry was leased by a co-partnery of six Edinburgh merchant-burgesses, and that they had obtained manufactory status by 1675⁷. French craftsmen were introduced including one Nicholas de Champ, who was to figure prominently in the early Scottish paper industry.

After a fire in 1675 the mill was rebuilt for "making gray and blue paper much finer than ever this country previously offered"⁸. After a second fire in 1679, Alexander Daes, the merchant burgess who had run the mill, was reduced to becoming the showman of an elephant. Although Daes later returned to paper making at Dalry, no more is heard of the mill; Daes died in 1684, and by 1699 the mill had reverted to corn grinding⁹.

Other Coarse Paper Mills

Long before the final demise of the Dalry Mill, paper mills had been established elsewhere in Scotland. At Canonmills, on the Water of Leith, one had been founded c. 1652; in 1659 it was held in tack by John Paterson who, in 1681 sub-let it to Peter Bruce, a German (Flemish) engineer¹⁰. Bruce spent £1,000 on the mill, and successfully petitioned for a monopoly in the manufacture and sale of playing cards. The patent was to have taken effect as from April 1st 1682, but in March of that year the mill suffered malicious damage which put it out of action: water was diverted away from the mill and Bruce's wife was thrown into the mill-dam. To keep going, Bruce built a small mill nearby, but in the following year, after obtaining recompense for the damage to his first mill, he left Canonmills, and moved to Woodside, near Glasgow, where John Campbell of Woodside was to have a new mill ready for him by 1st May 1683. Here too there were difficulties. On returning from a recruiting drive in Holland, Bruce found that Campbell and James Peddie,

the third member of the partnership, had been interfering with the mill and its workers, apparently with a view to preventing Bruce from fulfilling an agreement to buy Peddie out. Bruce brought an action before the Privy Council, and was awarded 1,000 Merks damages. Despite the success of this action, he left Glasgow and returned to Edinburgh where, in 1686, he established a mill at Restalrig, with James Home, one of the Dalry co-partners. In 1690 the mill and the playing-card monopoly were transferred to James Hamilton of Little Earnock; thereafter no more is heard of Bruce¹¹.

In 1661 the Register of the Great Seal refers to a paper mill at Spylaw, on the Water of Leith¹². According to Thomson, the Upper Spylaw mill dates only from 1681. in which year Sir James Lithgow started paper making there with help from Nicholas de Champ, who had left Dalry after the second fire¹³. It must be assumed therefore, that either the 1661 mill occupied a different site and was short-lived, or that it was, in fact, the same mill as that referred to in 1681. In either case, there was almost certainly a mill in the Spylaw area earlier than was previously thought. Apparently the mill was still in Lithgow's possession in 1700, and after his death in 1703, his widow held it in tack until at least 1704.¹⁴ De Champ seems to have left Lithgow's employment in the early 1680/s: in 1686 he was working for Bruce, and in the same, or the following year he moved to Glasgow and established his own mill at Cathcart on the White Cart Water. The mill prospered, and was still in operation

in the early 19th century¹⁵. Another mill was started at Ayton, Berwickshire, in 1693 by William Home. Little is known of the mill other than the fact that it made grey paper; Thomson assumes that the mill was short-lived¹⁶. In 1696, Patrick Sandilands of Coton established paper making on the River Don at Gordon's Mills, near Aberdeen¹⁷. Despite the establishment of these mills, imports of paper were still running at 6,000 reams per annum during the period 1685 - 1696¹⁸, probably because home production was confined to blue, grey and pressing papers, while writing and printing papers still had to come from outside. The production within Scotland of these latter classes of paper was to be the object of the most ambitious paper-making project of the era.

The Scott White Paper Company

In 1694 a company was floated, under the title of the Society of the White Writing and Printing Paper Manufactory of Scotland, the principal partners of which were Nicholas Dupin and Denis Manes. Dupin, a French Protestant of considerable ability, had already succeeded in floating six companies in England, Scotland and Ireland¹⁹. Under an agreement dated 27th November, 1694, Dupin and Manes on the one part and the subscribers on the other part, agreed to establish a joint-stock company with a capital of £4,200 Sterling. Seven hundred £3 shares were to be subscribed for in Scotland and an equal number in England; all were to be paid up in three six-monthly instalments, commencing 1st May 1695. To assist in the administration

of the company's business, thirteen people were to be employed at Edinburgh and a like number at London. Samples of paper sent from the company's London Office would be circulated in Scotland with a view to discovering "which shall prove most markittable and profitable", and whether it would be more economic to export paper to London or sell it within Scotland. Dupin and Manes were to pay £60 towards the cost of obtaining a patent in Scotland²⁰, £60 towards the construction of the company's first paper mill at Gifford, and £30 for recruiting skilled workmen. John, Earl of Tweeddale and High Chancellor of Scotland, had leased the Gifford site to the company for a forty year period, and with twenty shares, equalled Dupin. Manes, John Learmond (an Edinburgh merchant), and his own son, Lord Yester, as the largest share-holder. Among the smaller Scottish share-holders were to be found a book-seller, an advocate, a customs officer, an apothecary, a smith, a stocking manufacturer and a brewer; although dominated by landed and mercantile interests, the company seems to have attracted a wide range of small investors, drawn from the middle-classes²¹. Dupin contributed not only his entrepreneurial skill, but also his knowledge of technology: by a contract dated 16th August 1695, certain alterations were made to the original financial arrangements, and Dupin and Manes undertook to "oversee the building of two paper-milnes for makeing of white wryting and printing paper for the use of the said company and the buying and furnishing of all material necessarie for the said milnes, which milnes are to be

built and materials furnished thairto upon the companys charges, the one thair of at Yester and the other near Edinburgh²² whair the aire and water shall be found most agreeable for the makeing of good and sufficient whyte wryting and printing paper". Besides these duties, they were to train a vatman, a coucher, a leveer, a beaterman and a finisher for each of the two mills²³. From inventories compiled in 1704, it is apparent that the mills were built on similar lines. Besides "kooves" (vats) and presses, both had eight timber or stone mortars, each one holding three iron-shod hammers, worked by water power. A full inventory of the Yester Mill is given in Appendix C Paper, both white and grey, was made in imperial, crown and pot sizes²⁴.

As far as the functioning of the company was concerned, little is known; according to Scott²⁵, the venture ended in difficult circumstances after a short period. From the little information we have, this would seem to have been the case. Dupin and Manes seem to have got into financial difficulties, and in 1703 the mill, with a backlog of unpaid rent, was leased to a group representing the company. In the same year, the company's clerk was imprisoned for embezzlement. Despite the great number of subscribers, interest was so low that during 1704, four successive meetings failed to raise a quorum; in 1707, production was threatened by a shortage of rags²⁷. For all its difficulties, the Company managed to stumble on until 1715; in 1714 the Braid Mill had been given up and in the following year the untimely death of the

tacksmen to whom they had leased the Yester Mill forced the Company to write off the backlog of tack duty due to them and resign the feu held from the Marquis of Tweeddale, along with the mill which they had built at their own expense. In their representations to the Marquis, the partners of the paper company found no lack of reasons for their demise. It was claimed that they

"were imposed upon by Nicholas Dupine, a foreigner his luxuriant skems, and with a reasonable show of probabilitie of success, to venture in the prosecution of severall manufactories in company and, amongst the rest, your petitioners were involved in this of the paper manufactory, wherein wee advanced a considerable stock, in hope to have made it effectuall not only for the generall good of the nation, but likeways to our own privat advantage and profite. But this our society and company as well as oth'r societies & companys hes had a ruineing consequence of the loss of our stock and interest of it, tho really the design and project of the success of the manufactory hes taken place, in so far as there is a demonstration that paper can be made here tollerably good and serviceable for severall uses as is known, yet our being a company & the concern so ... divided in so many hands occasioning thereby not only a neglect of many things (that) might have been of advantage to the work, but the multitude of persons concerned brought on a great expences and charges.

It is also certain that the said Dupine, a foreigner,

made very inadvertant bargains in the first settlement giving rent for so much ground as might have made a purchase of so much land. And your lo(rdshi)p will be pleased to consider that the company payes a considerable few duty to your lo(rdshi)p for a very small piece of ground and upon which they have been at vast expences in erecting and building a paper miln and other necessaries about it and have lykeways for several years been throwing out money in hope att length to overcome all deficulties and bring the manufactory to a bearing. But after all, throw the unsteadiness of a society and their uncertain attendance assistance and advances, each trusting to and depending upon another, all at once failed."²⁹

This did not, however, mark the end of paper-making at Yester: since at least 1700, and probably earlier, both Yester and Braid had been making bank notes for the Bank of Scotland. By 1721 the Yester Mill, still carrying the Bank of Scotland contract, was in the hands of the Watkins family, Edinburgh printers and paper-makers, of English extraction. In that year, and again in 1723 and 1729, the mill was visited by bank officials³⁰ and from various other sources it can be shown that the mill continued to operate until the 1770/s³¹.

The Early 18th Century

The Watkins', printers first of the "Edinburgh Gazette" then of the "Courant", were not the only example of a link between Edinburgh printers and local paper mills.

On the death of her husband, Andrew Anderson, Agnes Campbell had succeeded to his title of King's Printer, and had staunchly defended it throughout the last years of the 17th century³². In 1708, at the age of seventy-one, she concluded an agreement with Sir John Clark of Penicuik whereby, in exchange for the tack of "a convenient stance", and the use of the River North Esk, she was to build a paper mill, pay £60 or so entry money, and provide one ream of the finest white paper, and one of coarse. by way of tack duty³³. In 1709 a tack was entered into to run for a period of 9 x 19 years from Martinmas 1708 at the higher tack duty of £86 Scots plus two reams of finest white paper and two of coarser white³⁴. The mill, later known as Valleyfield Mill, went into production in the late 1700's making paper which generally seems to have met with Clark's approval, with the exception of one batch in 1713 which he described as "sinking paper" - "can make no use except to give to my wife for receipts for kane fouls"³⁵. In 1716, the year of her death, Agnes Campbell sold the mill to her grandson, William Hamilton of Little Earnock, the son of James Hamilton who had taken over Restalrig Mill from Peter Bruce. In 1727 the mill came into the hands of the Watkins family³⁷. It was another Edinburgh printer, John Reid, who established Scotland's next paper-mill; in 1714 he leased Jinkabout Mill, presumably to supply paper for the "Edinburgh Gazette", which he had acquired in 1699³⁸. In 1717, the nearby Bogs or Vernour's Mill was converted from a corn mill to produce paper, by Nicol Lithgow, and in the same year

Redhall Mill, a few hundred yards upstream, on the opposite bank, started making paper under William Hamilton of Little Earnock³⁹.

The establishment of these three mills near Edinburgh, and a fourth, founded in 1716 at Cathcart, near Glasgow, is difficult to reconcile with the drop in Scottish paper production which took place in the early post-Union years: between 1712 and 1722 output fell from over 100,000 lbs to 40,000 lbs, possibly in response to the removal of trade barriers⁴⁰. Although production had returned to its former level by 1730, it was not until the mid-1740/s that it began to show signs of vigorous growth and a new era of mill building began. When that did happen, the technology and skills were already established in Scotland, and could be put to good use immediately. The distribution of paper mills for this period is shown in figure 4.2.

4.2



- 1 : Overton, J. in Singer, C., Holmyard, E.J., Hall, A.R.
& Williams, T.I. "A History of Technology" 5 vols
Oxford 1956-59 III 412
- 2 : Thomson, A.G. "The Paper Industry in Scotland 1590-
1861" Edinburgh 1974 3
- 3 : Cochran-Patrick, R.W. "Early Records Relating to
Mining in Scotland" Edinburgh 1878 81
Waterston, R. "Early Paper Making near Edinburgh"
BOEC XXV (1945) 56
- 4 : Waterston, op.cit. 56-7
- 5 : Ibid. 57
- 6 : RMSRS IX 1061
- 7 : Thomson, op.cit. 13
- 8 : Ibid. 13
- 9 : Ibid. 14
- 10 : Ibid. 10-11. Bruce's exploits had included supplying
Edinburgh with piped water from springs at Comiston
(1674) and both designing and building a harbour at
Cockenzie for the Earl of Winton (1678). In 1680
he obtained patents for a water pump to drain mines
and quarries, and an engine for cutting iron (slitting
mill?), mainly for nail-makers.
- 11 : Thomson, op.cit. 11-12
- 12 : RMSRS XI 93
- 13 : Thomson, op.cit. 14
- 14 : Ibid. 15
- 15 : Ibid. 16
- 16 : Ibid. 17
- 17 : Ibid. 18

- 18 : Ibid. 17
- 19 : Shorter, A.H. "Paper-Making in the British Isles"
Newton Abbot, 1971 16
- 20 : Waterston, op.cit. 65
- 21 : NLS MS 1913
- 22 : At Braid (GR NT247703)
- 23 : Waterston, op.cit. 62-3
- 24 : NLS MS 1913
- 25 : Scott, W.R. "Joint-Stock Companies to 1720" 3 vols
Cambridge 1910-12
- 26 : Thomson, op.cit. 18
- 27 : NLS MS 1913
- 28 : Thomson, op.cit. 18
- 29 : NLS Acc. 4862/15/f.1
- 30 : Waterston, R. "Further Notes on Early Paper Making
near Edinburgh" BOEC XXVII (1949) 46-7
Shorter, op.cit. 193
- 31 : NLS Acc. 4862/151/f.1 ; Caledonian Mercury Saturday, 4 June
1774
- 32 : Waterston, op.cit. (1949) 49-50
- 33 : SRO GD18/1317/B
- 34 : SRO GD18/889
- 35 : SRO GD18/1317/B
- 36 : Waterston, op.cit. (1949) 50
- 37 : Waterston, op.cit. (1945) 70; (1949) 50
- 38 : Waterston, op.cit. (1949) 49
- 39 : Thomson, op.cit. 119
: Waterston, op.cit. (1945) 70
- 40 : Thomson, op.cit. 74, fig.8
Shorter, op.cit. 193

COAL MINING

Between 1550 and 1700 Scottish coal production underwent an expansion which Nef has described as "revolutionary"¹ and while his figures represent only an estimate, it is probable that something like this suggested expansion, from 40,000 to 500,000 tons per annum did take place². Several factors favoured this growth. Much of the coal lay in churchlands and as such, had not yet been subject to large scale commercial exploitation. With the reformation and the emergence of a prosperous and commercially orientated landed class, the possibilities of coal as an export commodity, especially as an earner of Dutch riks-dollars, began to be appreciated. A well established Dutch merchant fleet could carry Scottish coal to wherever it could find a sale and, unlike the tiny Scottish fleet, could pay cash on receipt. In the face of such powerful vested interests the successive attempts which the Crown made to restrict, or at least benefit from, coal exports were doomed to failure³.

Within Scotland, the use of coal for domestic heating in Edinburgh and elsewhere kept several pits at work, while industrial development, notably in salt and iron, offered a ready market for otherwise unsaleable small coal.

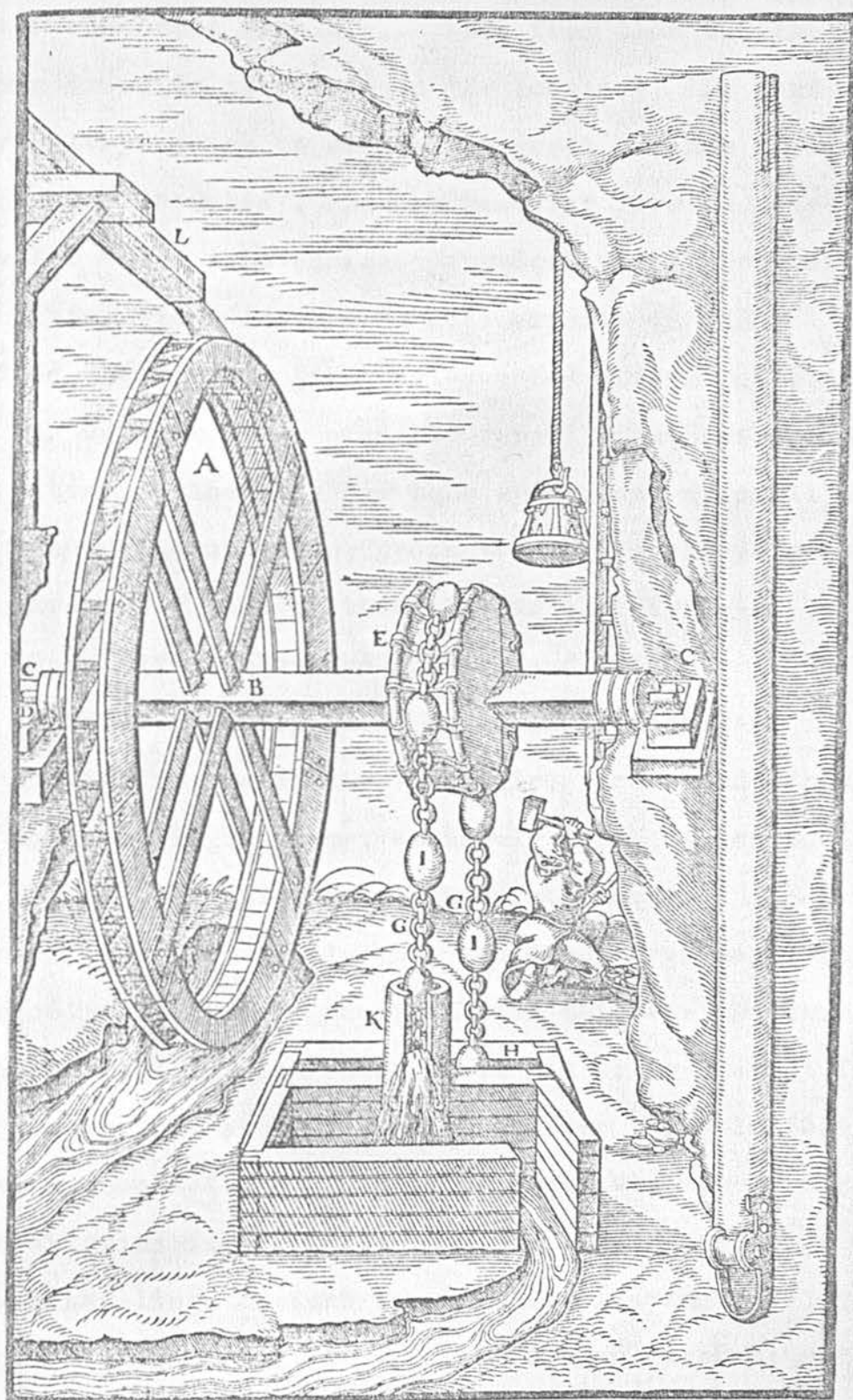
After the Regal Union of 1603, trade with London also developed.

Before coal reserves could be exploited on a large scale commercial basis, drainage techniques had to be improved. Illustrations in Agricola's "de Re Metallica" indicate

that by 1550 the use of water powered mine drainage was common in Europe (figure 5.1); by the 1590/s several such pumps had been installed by both English and Italian engineers to provide a water supply for London⁵. One of their number, Bevis Bulmer, was to figure largely in Scottish ore mining during the early seventeenth century⁶. The first water-powered pumps in Scotland appear in 1595, not providing an urban water supply, but draining flooded coal workings. In 1575, Sir George Bruce of Carnock obtained a lease of Culross Colliery, on the north shore of the Firth of Forth⁷. According to the preamble he possessed "great knowledge and skill in machinery", and was considered to be the person best able to re-open the then abandoned mines⁸. From a complaint made in 1607, it would appear that by 1595 Bruce had built a dam on the Muir of Culross, with a view to storing water to drive the mill at his coalworks⁹. In addition to the water mill or "engine", a horse-mill or "gin" was installed, and while it may have been the latter machine which drained the famous under-sea workings, the water engine must have made a useful contribution towards drying flooded seams¹⁰. As far as later developments were concerned, the water engine was certainly the more important. In 1598, Gavin Smith and James Aitchison (Goldsmith to King James), were granted a patent on a mine draining device, to be powered by wind, water, horse or men¹¹.

Development and Control

With expanding markets, and landowners eager to exploit new reserves of coal, it is hardly surprising that the



use of water-power in mining spread, particularly on the northern side of the Firth of Forth, where geological conditions made drainage necessary, and topography made water catchment feasible. When from time to time the crown tried to intervene in the industry, the coal owners were always quick to stress the great expense of establishing "water coilheuchis", and the need for foreign sales to pay for their maintenance. Typical was their reaction to restrictions imposed on coal exports in 1609:

"And first, thay (the coal-owners) afferme constantlie and we heir it by credible report of utheris, that the watter coilheuchis hes bene wyne, and ar still intertenued and upholdin, upoun very grite chargeis and expenssis, some of thame having alreddy coist the awnair above fiftie thousand merkis, and the poorest of thame surmounting every oulk, in ordinarie chargeis for intertenying of thair watter ingynis, three hundreth merkis, and utheris of thame, as namely Airth, Alloway, Carribdin and Sawchie, five or sex hundreth merkis".

Home demand, it was claimed, could not even pay for half the colliers' wages; coupled with this was the threat that without foreign sales, "all men wilbe skarrit fra unirtaking ony suche worke...heirefter"¹². In 1625, having conceded that point, the crown attempted to control the shipping in which coal was exported by imposing a tax of 48 shillings on each foreign ship loading coal, in the hope that this might stimulate Scottish merchant shipping. The coal owners, in turn, argued that the Scottish fleet was hopelessly inadequate in size, and that home sales

to have been typical of Scottish water engines (Figure 5.2).

would not support their "watter workis" for one month.

Needless to say, the tax had to be dropped¹³.

When, in 1631, it was proposed that English salt imports from Scotland be limited, the coal owners were quick to point out that "without the benefit of salt these sumptous (sic) water workes and mynes required for maintenance and wining the coale cannot be upholding". By this time, an estimated 10,000 people were employed in the Scottish coal and salt industries, and any threat to coal owners was seen as endangering their mine drainage systems, the working of which was vitally important if employment was to be maintained¹⁴. In 1634¹⁵ and again in 1641¹⁶, pressure from the economically powerful mine owners led to the abandonment of legislation.

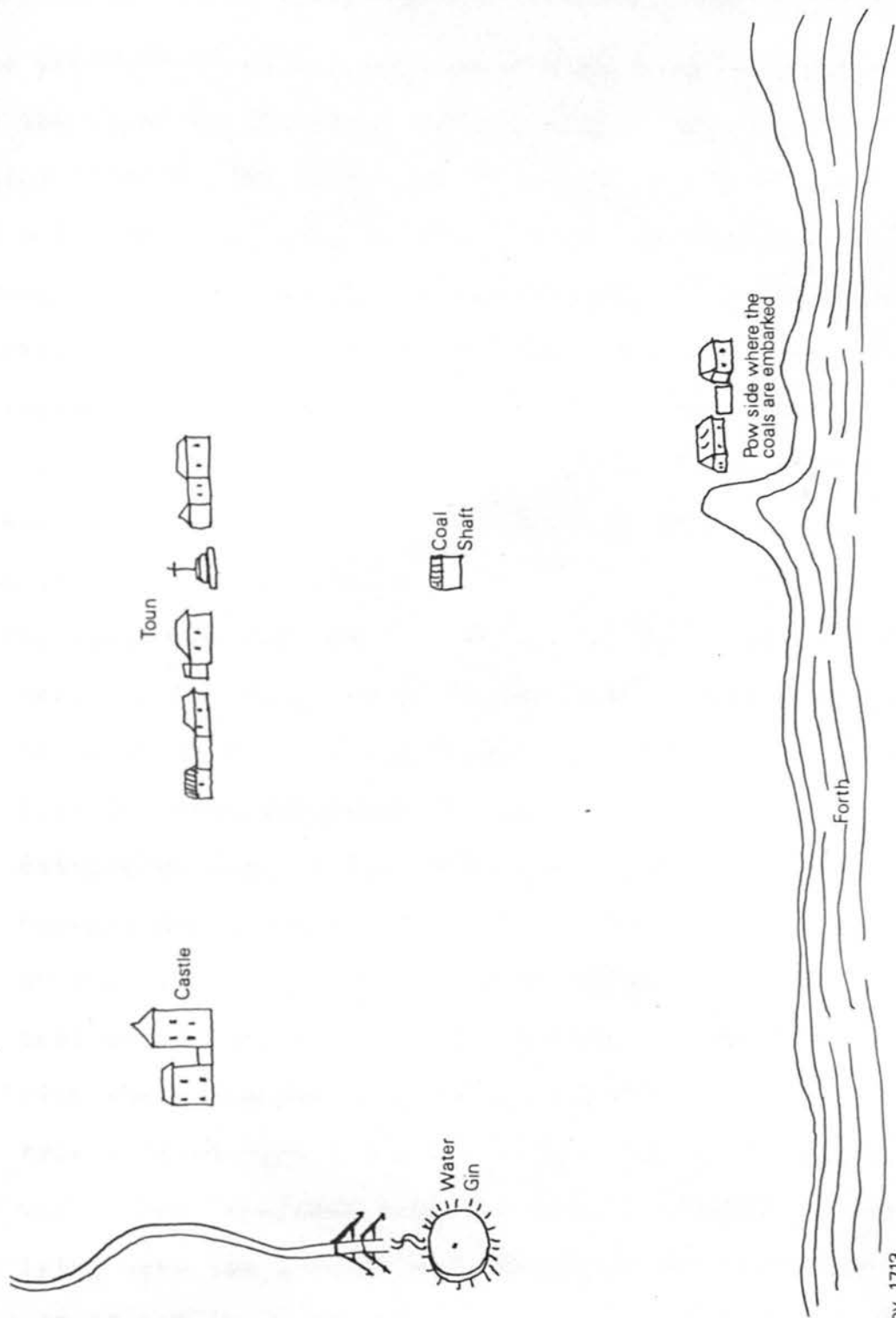
Construction and Maintenance

It would be tempting to see as exaggerated the claims made as to the expense of "water coalheughs", were it not for other contemporary evidence. In 1661, at Cameron, Fife, the Earl of Wemyss was empowered to "set doun sinks, coal piteyes, levelles, and to erect windmills and watermills and other things necessary for winning and transporting ...coal"¹⁷.

During the course of the next seventeen years he spent no less than £100,000 Scots (over £8,300 Sterling) on improving his collieries and building a new harbour at Methil¹⁸.

A wheel which was to be installed on a 44 fathom sink at Clackmannan, in the 1690's, was reckoned to cost 57,000 Merks (£3,166 Sterling)¹⁹. Large overshot wheels, with elaborate lade systems and sometimes extensive dams appear to have been typical of Scottish water engines (figure 5.2).

5.2



With such substantial works to undertake it is hardly surprising that a heavy capital investment was required.

The problems of maintenance is perhaps best exemplified by the wheel at Thornton, East Lothian. At some date prior to 1678, 392 deals and 82 couples had been used to build the elaborate system of dams and elevated wooden troughs which served the over-shot wheel on Thornton Coal-works. The iron chain, 23 fathoms long, had thirty buckets attached to its length, each with three iron hoops²⁰.

For all this investment, it was not long before difficulties arose, and by October 1681, the working of the system had run into serious problems:

"To speak shortly and in generall of the conditione of these works, they are so ruinous and decayed that (if not prevented) in a very short tyme they will either totally ruine and decay or else come into such a conditione as they cannot easily be recovered without great charges and expenss, ffor the aquaduct from the head therof all along (where it is artificial) is for the most pairt furred and shott together. The dammheads with there slouces broken doun and decayed. The short trowes fixed upon Innerwick bridge for carrieing the water over Innerwick burn are totally overturned and lying upon the ground, and the timber belonging thereto all if not the most part stollen and miscarried. The long trowes which carries the water from the aquaduct to the wheill are in so chattered and ruinous a conditione that if not speidily helped they will altogether perish and decay. The water wheill in so defective a conditione

that shoe will not weill be able to move without reparatione. The great iron chaine so weakened and bouked...that it hardly can be of any use till it be laid in a forge. The buckets being 28 or 30 are all wanting except 8 or 10 which are in no good conditione. The materialls and instruments belonging to the work ...are embezeled and wanting. The old bearing sinck in such a conditione that (if not guarded against) will be lost and clapt together to the very great prejudice of the work. The iron-work of the axeltrie such as gudges, chainie bands and other iron work belonging thereto all of them defective".²¹

Distribution

However great the cost might have been, water "engines" continued to be built. George Sinclair, writing in the 1670's speaks of them as being common, and identified two types. The first involved the use of a continuous chain with detachable buckets which scooped up water and emptied it into a trough as the buckets turned over an axle-tree at the top. The second system also used chains, but fixed with plates instead of buckets. As the plates passed upwards through hollow pipes, they lifted water to the surface, where it discharged into a trough²².

When it comes to identifying individual sites however, evidence is fragmentary. What little information there is has been used to compile figure 5.3. On the basis of this, it would seem that during the seventeenth and early eighteenth centuries, water engines were installed at many collieries on the north side of the Firth of Forth,

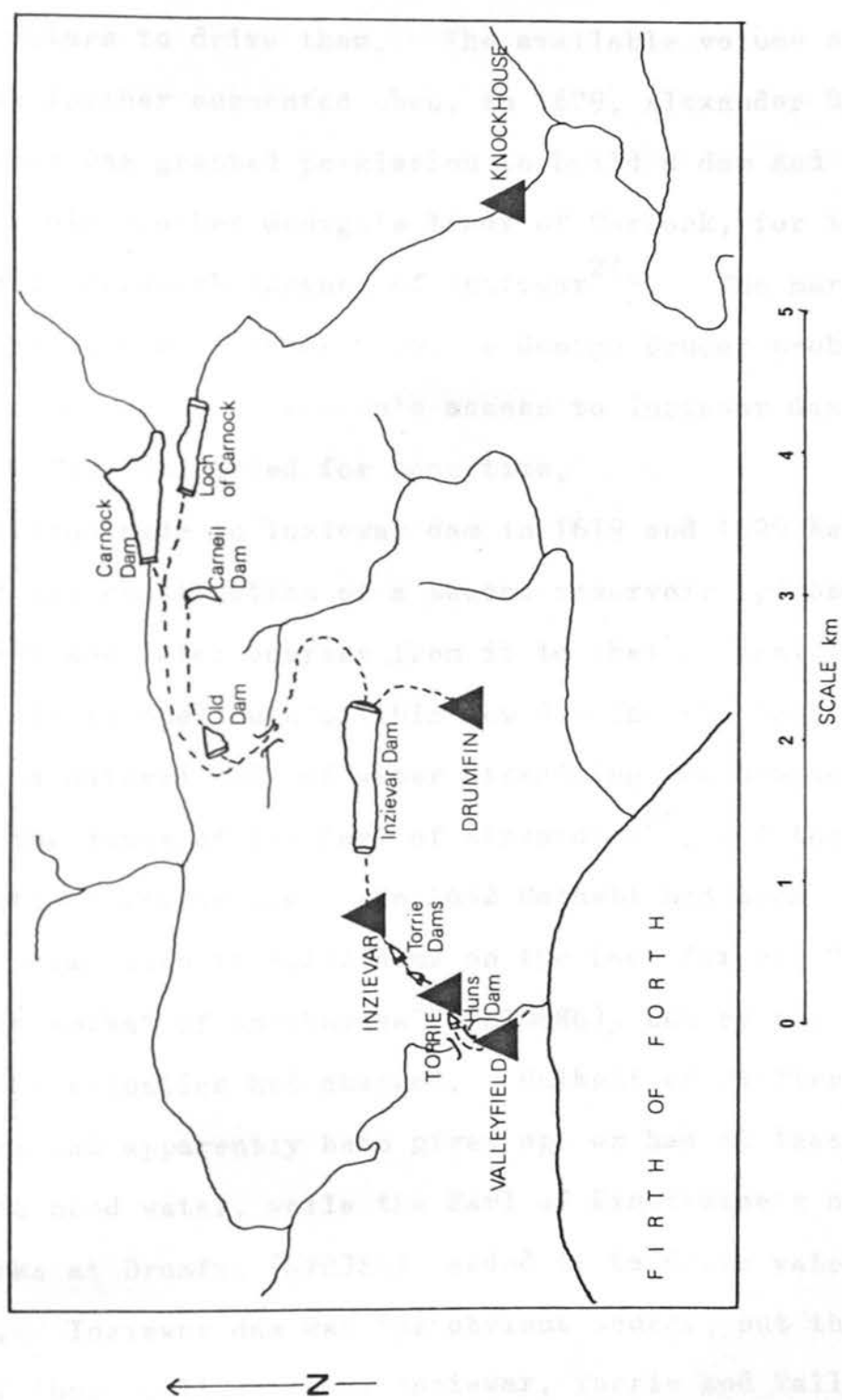
5.3



but few on the south side. With the exception of some on the Ayrshire coast, collieries in the west of Scotland were hemmed in by land, and could not therefore, expand to the extent that those in the eastern coalfields could. In the Lothians most mines could be drained by levels, and where this proved impracticable, horse gins were usually adequate for drainage requirements; large sums were invested in both methods. The Mid- and East Lothian coalfield, with its proximity to Edinburgh, and its limited coastal exposure, was orientated towards land sales, though some exporting mines were created during the period.

Water Engines in South-West Fife

Despite the paucity of information for Scotland as a whole, developments in one small area, to the east of Culross, are well documented, and can therefore serve as an illustration²³. At some date in the late sixteenth or early seventeenth century, a reservoir by the name of Inzievar dam (NT0387) was constructed in Torryburn parish, Fife, probably to drive water engines on the Torry coal, but possibly for those on the Valleyfield coal (figure 5.4). Two smaller dams, the over and nether dams of Torrie, may date from the same period. In 1612 Preston of Valleyfield was granted the right to mine the coal of Valleyfield, and during the years that followed, extended the workings under the Firth of Forth, in much the same way that Sir George Bruce had at Culross. To drain these workings, Preston installed a water engine which was linked to the existing lade system on the opposite side of a deep ravine, by an elevated wooden trough supported on posts. The



coal of Inziewar was, in 1619, held in tack by Roger Duncanson, an Edinburgh merchant burgess. He too installed water engines to drain his coals, but had to lay on additional water supplies to Inziewar dam before he was permitted to use its waters to drive them. The available volume of water was further augmented when, in 1629, Alexander Bruce of Inziewar was granted permission to build a dam and sluice on his brother George's lands of Carnock, for the use of his "coalwork ingynes of Inziewar"²⁴. The marriage of John Preston's daughter Mary, to George Bruce, probably helped to ensure that Preston's access to Inziewar dam would continue unimpeded for some time.

The additions made to Inziewar dam in 1619 and 1629 had involved the construction of a second reservoir (probably at NT0489) and water courses from it to that at Inziewar. Immediately to the south of this new dam lay the Loch of Carnock, a natural body of water straddling the boundary between the lands of the Earl of Kincardine²⁵, and those of Halkett of Pitfirrane. In 1642 Halkett had been granted permission to build dams on the Loch for his "coal and water works" of Knockhouse²⁶ (NT0686), but by the mid-1650's the situation had changed. Halkett of Pitfirrane's coalworks had apparently been given up, or had at least ceased to need water, while the Earl of Kincardine's new coal works at Drumfin (NT0386) needed it to drive water engines. Inziewar dam was the obvious source, but the needs of those collieries at Inziewar, Torrie and Valleyfield were already putting a strain on its limited capacity. The problem was solved by linking the Loch of Carnock to

the system of lades which fed Inzievar, thus extending the latter's catchment area. In 1654 Alexander Bruce, brother of Edward, Earl of Kincardine, was granted permission to build dams at Halkett of Pitfirrane's end of the Loch of Carnock, by which means its level could be raised to a height sufficient to divert the water into the lades serving Inzievar dam. In the event of Halkett's needing water for his coal works, the dams were to be lowered again, and the agreement to be annulled²⁷. To accommodate the additional volume of water, Inzievar dam was extended to cover 60 Scots acres, and the turf damhead enlarged to give a total length of 500 feet, a height of 10 feet and a thickness at the base of 30 feet. A cutting in the opposite (i.e. western) end of the dam released the water which drove the Drumfin engine. The turf damhead at Carnock Loch was 400 feet long, 46 feet thick and 5 feet high. Together, these two reservoirs covered about 40 Scots acres. A compensation reservoir at Carneil had a stone damhead 12 feet high and 22 feet thick.

The Torrie coal was given up in 1663, and that at Drumfin in 1673, but Valleyfield continued to use the waters of Inzievar dam until the eighteenth century. With such "sumptuous water works" to construct and maintain, it was hardly surprising that overseas sales were so vital.

The Early Eighteenth Century : Alloa Colliery

By the early eighteenth century the search for more efficient water engines was "the great object in view with all coal-masters"²⁸. One such man was John, Earl of Marr, owner of the coal works of Alloa. In 1709 he sent his colliery

manager to Newcastle, at that time the most advanced area in Britain in the technology of mining. As a result of the visit, the Earl obtained drawings of machinery in use there and, wishing to apply such machinery to his own mines, he engaged George Sorocold of Derby²⁹ to prepare plans. Sorocold duly visited the mines, stayed for several days and received £50 for his services. The most significant innovation which he recommended was the substitution of pumps, worked by cranks on a water wheel, for the traditional chain and bucket engine. Unfortunately, no millwright capable of constructing such a machine could be found in Scotland, and in the event the new wheel was built with chain and buckets³⁰.

The Earl of Marr had the misfortune to be on the losing side in the 1715 rebellion, and as a result of forfeitures, the Alloa collieries deteriorated. When, in 1723, the situation was finally taken in hand, it was found that two powerful engines would be required, and that in the absence of sufficient water supplies, one would have to be driven by steam³¹. This expensive and unpopular measure was avoided however, by the construction of Gartmorn Dam, an extensive reservoir fed by a 3 Km long lade taken from the River Black Devon. Damages of £36 Scots were paid to the owners of the land which it occupied³². In the nineteenth century, water from the dam was still powering coal engines, besides several other mills.

Conclusion.

By investing so much capital and effort in deep mining, the commercially orientated landowners of the period were able to increase output many times over, while sales to

overseas markets, either directly or in the products of the closely linked salt industry, enabled them to accumulate the capital necessary for the maintenance and further investment in the expensive plant needed for such mining. Both in Scotland and in England, the increasing need for fuel in the salt, lime burning, iron working and glass making industries further stimulated production. The domestic use of coal, already well established in Scotland, became increasingly popular in London, as timber became scarcer and scarcer. Many mines could be worked successfully with levels or horse gins; in some places, however, the absence of water engines was enough to close a mine: the Harperhill Coal on the Alloa estate was wrought for a while, and sold well, but by 1714 it had been given up as unprofitable for, as was said at the time, "water cannot be brought to it for making a machine serviceable to drain it"³³. It should be noted too that when the steam engine first appears in Scotland it is as a means of lifting water to drive water wheels for mine drainage. In 1701 James Smith of Whitehill, near Edinburgh, obtained the Scottish rights for Thomas Savory's engine³⁴. Smith may not have sold any steam engines, but he is known to have advised at least one potential customer to use one to pump water for a 20 foot overshot wheel, at a point only 10 feet above high tide level³⁵. Only four Newcomen engines have been identified in Scotland for the period up to 1730³⁶; had water power been available, it is unlikely that steam engines would even have been contemplated, and for another hundred years or so, water engines were to continue to offer a viable alternative to steam.

- 1 : Nef, J.U. "The Rise of the British Coal Industry"
2 vols. London 1932
- 2 : Ibid. I 19
- 3 : APS II.543, No. 22 (1563); III.147, No. 28 (1579)
- 4 : Agricola (Hoover, H.C. & Hoover, L.H.(Eds)) "De Re Metallica" 1556 (New York, 1950)
- 5 : Armytage, W.H.G. "A Social History of Engineering"
London, 1961 72
- 6 : Bulmer was also responsible for a sitting mill, patented
in 1588; see also page 98 et seq.
Gale, W.K.V. "The British Iron and Steel Industry"
Newton Abbot, 1967. 28
- 7 : Bowman, A.I. "Culross Colliery: A sixteenth Century
Mine" IA VII (1970) 355
- 8 : Cochrane, A. "A Description of the Estate of Culross"
Edinburgh, 1793. 9 - 11
- 9 : RSSRS 1st Series VII 314
RSSRS 2nd Series VIII 267
- 10 : Bowman, op.cit, 353-372
- 11 : National Coal Board "A Short History of the Scottish
Coal-Mining Industry" 1958 42
- 12 : RSSRS 1st Series VII 568-9
- 13 : RSSRS 2nd Series I 169-70
- 14 : RSSRS 2nd Series IV 255-7
- 15 : RSSRS 2nd Series V 341
- 16 : RSSRS 2nd Series VII 160
- 17 : RMSRS XI 111 (1681)
- 18 : Pryde, G.S. "Scotland from 1603 to the Present Day"
Edinburgh 1962 29

- 19 : SRO GD76/358
- 20 : SRO GD6/1256
- 21 : SRO GD6/1254
- 22 : Sinclair, G. "The Hydrostaticks" Edinburgh 1672 298-300
- 23 : Much of the information on Inzievar dam comes from
a Court of Session case, Erskine of Carnock v. Preston
of Valleyfield. OSP 4:87, 80:1
- 24 : SRO GD15/897
- 25 : i.e. Edward Bruce, son of George Bruce the younger
- 26 : Webster, J.M. "History of Carnock" Dunfermline 1912
224
- 27 : SRO GD15/900
- 28 : Bald, R. "A General View of the Coal Trade of Scotland"
Edinburgh 1808 10
- 29 : The same George Sorocold designed the great water
wheel for Britain's first factory, the Derby silk
mills. Armytage, op.cit. 79-80
- 30 : NSA VIII 27
- 31 : SRO GD124/17/532
- 32 : SRO GD124/17/539
- 33 : SRO GD124/17/532
- 34 : Dickinson, H.W. in Singer, C., Holmyard, E.J. Hall, A.R.,
& Willis, T.I. (Eds) "A History of Technology" 5 vols
Oxford, 1956-59 IV 172
- 35 : SRO GD246/63/4
- 36 : Duckham, B.F. "A History of the Scottish Coal Industry"
I (1700-1815) Newton Abbot, 1970. 365-8

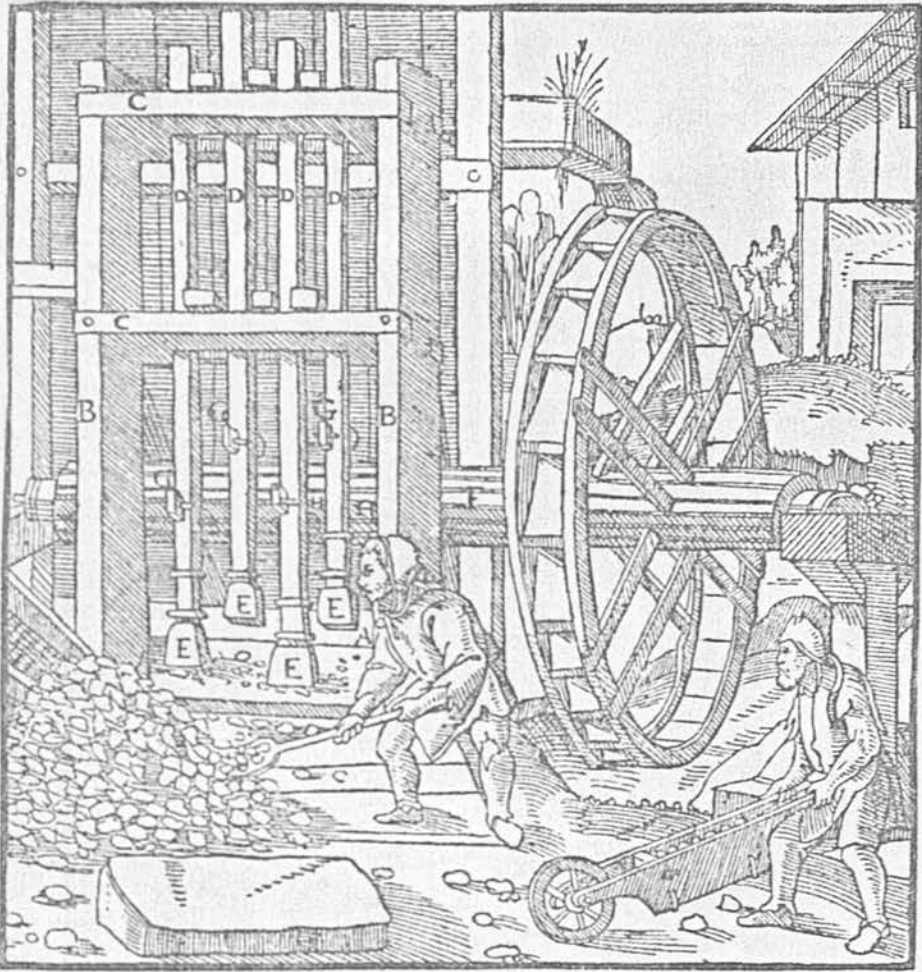
THE MINING AND MANUFACTURE OF NON-FERROUS METALSTechnology

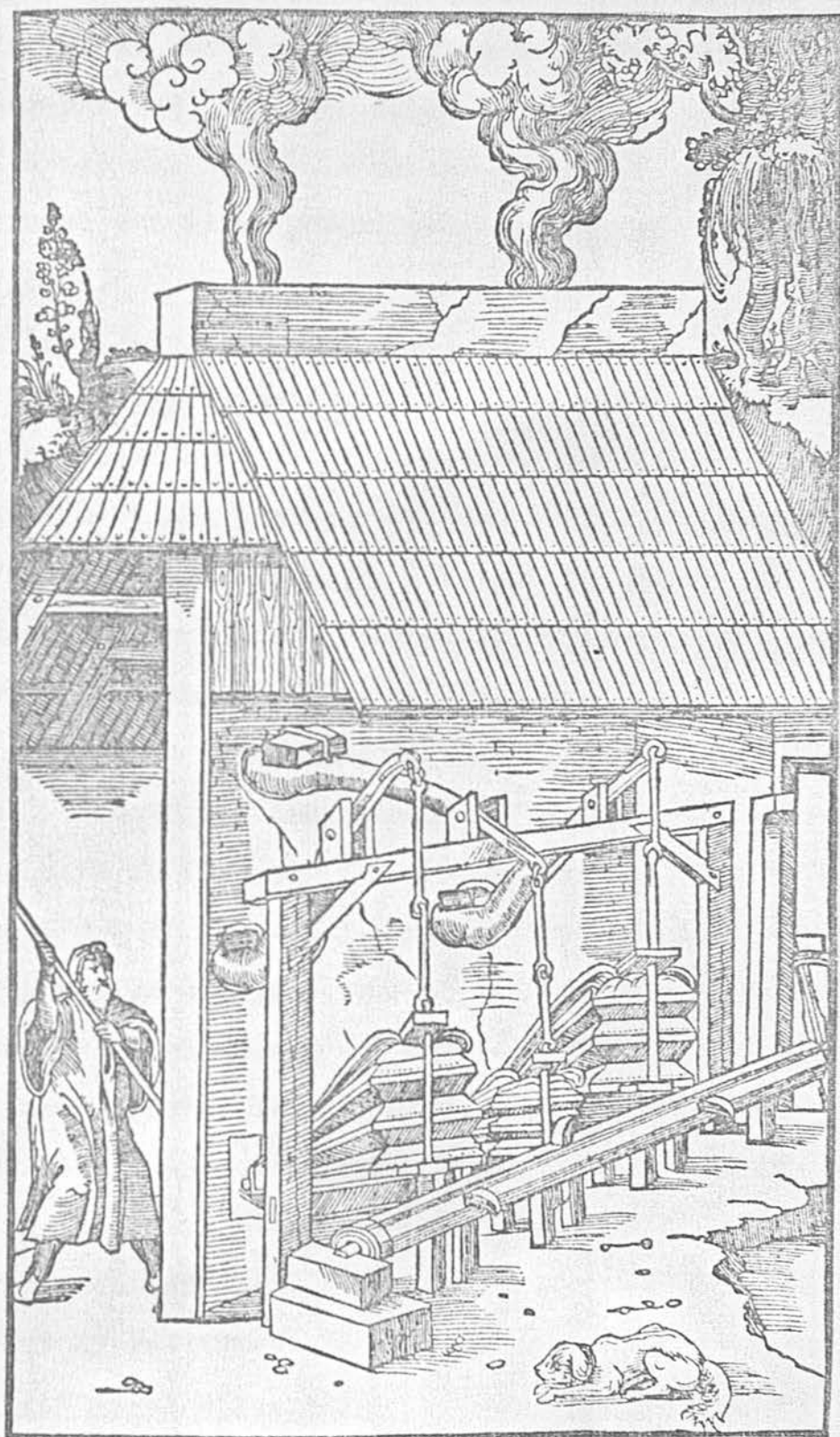
Just as European drainage technology was applied to the Scottish coal industry in the late 16th and early 17th centuries, so also was the technology of crushing and smelting applied to the refining of non-ferrous metals. Crushing plant, first referred to in the early 1600's (p. 99), probably consisted of vertical, water-powered stampers, of a kind already in use in Cornwall and still known as "Cornish Stamps" (figure 6.1). Finer particles might be broken down by grindstones.

Carew's "Survey of Cornwall", published in 1602, provides a good description:

"Three, and in some places sixe great logges of timber bounded at the ends with yron, and lifted up and downe be a wheele, driven with the water, doe break it (the ore) smaller. If the stones be over-moyst they are dried by the fire in an yron cradle or grate. From the stamping mill it passes to the crazing mill, which betweene two grinding stones, turned also with a water wheel, bruseth the same to find a sand; howbeit, of late times they mostly use wet stampers, and so have no need of crazing mills for their best stuffe".¹

The use of water power in smelting mills was confined to operating bellows employing the same axle and cam system which drove stamps (figure 6.2). As far as can be discerned, the earliest smelting mill in Scotland was that of Thomas Foullis, established c. 1592 (p. 98).





Although water power was extensively used at a later date in the drainage of lead mines, those of the period under consideration were probably drained by levels or, possibly, horse gins: only one reference to pumps (not necessarily water-powered) has been found for the 17th century and not until the 1720's, with the advent of improved bob-engines, was water power definitely brought into use (p.104).

Foreign Exploitation of Mines

While the exploitation of coal reserves was primarily in the hands of estate owners, the skills and capital required to mine and manufacture lead, silver and gold were beyond most Scots. In order to exploit these minerals as a means of increasing revenue, the Crown initially granted rights to foreigners, notably Germans and Flemings: Cornelius de Vos and Abraham Petersen in 1567², Arnold von Bronchorst in 1572 and Abraham Petersen once more in 1576³. A few Scots, notably the Duke of Atholl and George Douglas of Parkhead, figured in this early period of exploitation⁴ but in 1583, with the transfer of all mines and mineral rights to a Fleming, Eustacius Roche, for 21 years, all existing rights were annulled⁵. However, under pressure from such parties as the Lindsays of Glenesk and in the face of suspected non-payment of dues, Roche's rights were, in turn, annulled by Act of Parliament in 1592.

The Act Anent Mines 1592

The removal of Roche no more than cleared the ground for the Act's other, more extensive, provisions. At a time

when private capital was beginning to be channelled into the development of other industries, such as paper-making (p. 69) and coal mining (p. 82), it is interesting to note the importance which the Crown attached to ensuring control of gold, silver and lead mining and, significantly, the refining of these metals in Scotland, a process which had previously taken place abroad, much to the detriment of the Scottish economy. Predictably, the "Act Anent Mines" starts by recounting the shortcomings of licensing aliens "quha nather haid substance to caus labour and wirk the hundreth pairt of ony ane of the saidis mynis nor yit instructed vtheris liegis of this realme in the knowlege thairof"⁶. In place of this system, mineral rights were to be feued to the proprietors of ore-bearing lands and a new Office, that of Master of Metals, was to be created to co-ordinate mining operations and to supervise the collection of duties. Without his consent no mineral-working contract was considered to be legal; he was empowered to hire workmen, both Scottish and foreign, to set up markets for foodstuffs and roads to provide access to mines. In pursuit of his duties, he could take "places for all maner of houssis mylnes mylne landis fornaceis and fyre out of the nixt adjacent mossis and woddis necessar for thar workis". To attract labour and to compensate for dangerous working conditions, workers in the industry were exempt from taxation and from other duties such as military service and quartering troops (cf. p. 60) Special courts were to be established in each shire which could by-pass the cumbersome legal

system and resolve disputes more readily⁷. The post of Master of the Metals was to be occupied by John Lindsay, the parson of Menmuir, Angus, who had been instrumental in bringing down Roche; besides being a prospector of great renown in his own country, Lindsay had visited England, Germany and Denmark, where he had built up a good knowledge of mining techniques. Perhaps the most significant advance, however, was in the refining of metals within Scotland. Previously, ore had been exported to Flanders where it was refined and sometimes re-imported into Scotland. While the Crown derived a little income from export duties most of the benefit accrued to the country in which refining took place. The Act Anent Mines sought to remedy this situation by establishing refining plant in Scotland. Apparently such plant already existed. In the early months of 1592, Thomas Foullis had been sent to London to consult Sir William Bowis; back in Scotland, he was to build "ane strang and large house" in which the reduction of metals for coins could take place under Bowis's direction⁸. As an Edinburgh goldsmith Foullis had amassed great wealth and, having lent to the Crown, he was well favoured by the king. It may well have been in connection with the above activities that his smelting mill, mentioned in the Act, was set up:

"...Thomas foullis gouldsmyth hes found out the Ingine and moyane* to caus melt and fyne the vris of mettallis within this cuntrie and hes brocht in strangearis and

*
i.e. means or way

beiggit houssis and mylnis for this effect to his grit coist and expenss and to the grit and evident weilfair of the haill cuntrie within the quhilk no vre in grit wes never meltit of befoir and fynit: bot the same wes evir transportit out of the cuntrie vnmeltit and refynit".

The smelting mill was to refine all the metal ores won and wrought in Scotland⁹ and the officials of burghs and free ports were asked to ensure that no metals were exported unrefined¹⁰. As to the location of the mill, it was almost certainly at one of the two places on the Water of Leith that bear the name Silvermills¹¹, that at Leith being the more likely.

Conflicting Authorisations

However clear and ambitious the provisions of the Act may have been, the decade or so which followed saw much confusion in the industry, with conflicting claims to minerals in the Lowther Hills and in West Lothian. In the year which saw the passing of the Act, Thomas Foullis took over the Glengonnar mines at an annual rent of 500 Merks and, in the following year, the mines on Friarmuir, Lanarkshire, at 1,000 Merks. To assist him in his searches Foullis engaged Bevis Bulmer, an English prospector and engineer, who had been associated with ore mining in Scotland since the late 1560's¹². Among his more original ideas was the creation of "Golden Knights" who, in exchange for a knighthood, were to give £300 towards mining operations. Bulmer was to take overall charge of the mines, it being proposed that "clouses, dammes and water-

courses be made fitting to the ... gold workes and washing of gold, etc., and that all sorts of water-mills. stamping-mills and plash-mills" be erected¹³. Despite the failure of this particular scheme, Bulmer received financial help from the Crown between 1603 and 1606 and in the latter year he was granted a tack of all the precious minerals in Scotland¹⁴. Up to three hundred men were employed in various operations and at Long Cleuch Head, where a small vein of auriferous quartz had been found¹⁵, Bulmer built a stamping mill. Although he succeeded in obtaining some "small mealy gold"¹⁶, serious damage was done to the mills in 1607, when various persons "reft the haill trows, stamparis, burdeis, wheillis, extreis and uther furn-toure"¹⁷.

During the same period, George Bowes, working in the Lowther Hills, was also in receipt of financial help from the Crown¹⁸. Bowes had built houses for his skilled English miners near his workings along Wanlock Water, but had been consistently hampered by bad weather, outbreaks of scurvy and harassment by Thomas Foullis, on whose behalf Bulmer was working in the area. Workmen were bribed away and operations interfered with; by the end of 1604, Bowes had given up¹⁹.

Unlike the unfortunate Bowes, Bulmer continued to go from strength to strength. In 1606 a collier, Sandy Mauld, stumbled across a piece of "red metal" at Hilderstone, near Linlithgow. A sample was sent to Bulmer who, on testing it in his assay furnace, found

it to be rich in silver. Before long, Bulmer was engaged in mining the metal²⁰.

Bulmer's original role at Hilderstone is difficult to assess: the property belonged to Sir Thomas Hamilton who, in 1607, took on the post of Master of the Metals and until the end of 1607 he and Bulmer had conflicting royal authorisations²¹. By the spring of 1608, however, the position had been clarified and in exchange for generous compensation, Hamilton yielded his interest in the mine to the Crown²².

Under the new Mines Royal, Bulmer became governor, George Bruce of Carnock (the coal owner) was appointed treasurer and Archibald Primrose²³ was made secretary²⁴. To refine the silver ores, the smelting mill at Leith (probably that built by Foullis) was repaired²⁵ and in 1609 new stamping and smelting mills were built on the Loch Burn, Linlithgow²⁶. Between the 3rd July 1608 and 7th May 1609 no less than £20,135 10s 10d Scots was spent on building and running the silver mills, an indication of the importance attached to silver production. The mines themselves were on a large scale, employing over sixty men²⁷; pumps, probably designed by Bulmer and possibly using water power, were used to keep the workings dry²⁸. For all the capital sunk in the exploitation of the silver deposits, the mines failed to live up to expectations and in 1613 mines, "fyre workis" and stamping-mills were handed over to a group headed by Thomas Foullis, though the Crown continued to maintain a monopoly of its product²⁹. Foullis continued to use the crushing and smelting plant³⁰, but on

the whole the group seems to have had little success in mining and by 1652 only a few stones remained of the ruined mills³¹.

For all the hopes which it had held out, the Act Anent Mines seems to have been a failure. Scottish involvement in mining had increased but so also had that of the English who were taking over where the Germans and Flemings had left off. Twenty years after it had first appeared, the Act had still not been implemented³², while over the period 1611 - 1614 the average annual value of "leid urris" leaving the country was almost as great as that of coal and nearly twice that of linen cloth³³. On the other hand, the initiative behind it and the fact that a Scot had gone so far as to build a smelting mill in Scotland, both show a desire to improve the state of the Scottish economy and an attempt to move away from exporting basic, unrefined commodities. Furthermore, the change of policy as to who should search for and exploit the mines produced so enthusiastic a response that by 1649 there was some alarm over the extent to which ground had been broken, woods and orchards destroyed and property damaged, all in the course of over-zealous mineral prospecting³⁴.

Leadhills and Wanlockhead 1615 - 1730

Despite widespread prospecting only Leadhills and Wanlockhead provided ore in any quantity and, while other deposits came to light after 1730, lead mining in Scotland from 1615 up to the 1720's was largely confined to these two adjacent localities. It is therefore worth

considering their development in detail, not least because both furnish examples of the use of water power.

Bevis Bulmer died in 1615 and in the same year his friend and assistant, Stephen Atkinson, was granted permission for life to search for and exploit the mines on Crawford Moor. Atkinson's stay does not seem to have lasted long however, for in 1621 the same mines, with others, were leased to a physician, John Hendlie, for a period of 21 years³⁵. Throughout this period, overall control remained with the Foullis family: Thomas was succeeded by his brother Robert and in 1637, on the latter's death, Anne, his only surviving child, inherited the mines³⁶. Through her marriage to Sir James Hope of Hopetoun, the Foullis mines in the Leadhills area passed to the family which became the Earls of Hopetoun³⁷. On his first visit to the mines on 29th May 1638, Sir James found two smelting mills with water powered bellows, one in poor condition and the other perpetually out of use. By the time of his second visit on 7th October 1639, one mill had been rebuilt but the other, for double bellows, was in no better condition than it had been the previous year³⁸.

Under the family the mines seem to have prospered and by mid-century the Leadhills mines, then the only ones in Scotland, had been wrought to a depth of twenty-four fathoms, and were producing three to four hundred tons of ore per annum, giving employment to fifty workers³⁹. Notwithstanding the existence of smelting furnaces in the late 1630/s, much of the output from the mines was sent, according to Smout, to Holland as unrefined galena⁴⁰.

However, there were certainly facilities in Scotland by the early 1690's, when a new slaghearth was incorporated into an existing smelting mill⁴¹ and in the same decade the Earls of Hopetoun established a wind powered crushing and smelting-mill at Leith⁴². The family still owned the mines in 1730 and continued to do so for long afterwards.

In 1675 there were favourable reports on deserted workings at Wanlockhead, on land belonging to the Duke of Queensberry⁴³. In 1680 Sir James Stampfield took a lease of the mines, during which he built a smelting-mill and houses for workers. In 1691 a new lease was made out to Arthur Wall and Matthew Wilson, both of County Durham, for a period of nineteen years. The terms of the lease granted them permission to make shafts and levels, "with libery also of watergates and other ingines necessary for carrying of the water from the said mines". This latter clause is almost certainly a reference to water powered drainage. Wilson and Wall were either to build new houses and a "lead miln for melting the lead oar", or to repair the existing ones; the making of watercourses was also specifically mentioned⁴⁴. From this time onwards smelting was to be concentrated at the place of extraction, a move facilitated by the substitution of peat for charcoal in refining⁴⁵.

Meanwhile, in England, further developments were taking place. In 1692, William and Mary granted to Constantine Vernatty a charter incorporating "The Governor and Company for Smelting down Lead with Pitt Coale and Sea Cole"⁴⁶. By 1704 Quakers with mining interests in North Wales and

Northumberland had taken over control of the company⁴⁷ and when, in 1709, Wilson and Wall gave up the Wanlockhead mines, the "Governor and Company" obtained a lease of them from the Duke of Queensberry. Under the lease, the Company was to pay a rent 1/7th of the dressed ore produced, and to smelt it if asked to. The Duke was to take a twenty-five per cent stake in their profits and working costs⁴⁸. Despite initially poor results, the discovery and working of the New Glencrieve vein gave much better yields⁴⁹. In England the Company were using the newly-invented reverberatory furnace but it is doubtful whether they introduced it to Wanlockhead, an area with adequate water power but with relatively poor access to coal. Furthermore, it is unlikely that the Company did, in fact, use coal to smelt at their Scottish mines. In 1721 the "Friendly Mining Society", with partners in Edinburgh, Newcastle and London, joined forces with the Smelting Company and together they worked the mines until 1727, when the partnership split and the two companies took on separate sectors of the field⁵⁰. The new, improved pumps which were being applied to the coal industry in the early 18th century also found their way into lead mining: according to Smout⁵¹, a bob gin was installed at Wanlockhead in the 1720/s, while Brown⁵² refers to water-wheels installed by the Smelting Company, though probably after 1730.

Conclusion

By the 1720/s, lead mining and smelting in Scotland were well established, if still financially risky activities. The use of water power, firstly to provide the blast for smelting-mills, later, where "levels" proved inadequate, to drain mines, had contributed to the wealth of Scotland and to the strength of her economy: as Smout points out, a ton of smelted lead brought twice the price of a ton of ore. The construction of a road from Leith to the Wanlockhead/Leadhills area had gone some way towards easing the problem of transporting ore for export; a much greater improvement, however, could be achieved by smelting ore at the mines, thereby reducing its bulk by nearly two thirds⁵³. Furthermore, once Scotland had her own lead smelting capacity, there was no need to export lead ore and re-import it as lead; what lead she needed could be procured from within Scotland and a surplus, if any, could be exported as a much more valuable commodity than lead ore.

On the other hand, results were, in some respects, disappointing. The capital needed to open up and exploit mines was great, and the risk of failure high. Even the Leadhills/Wanlockhead area, which consistently dominated Scottish lead production from this period onwards, was small by English standards and miniscule by those of Continental Europe; despite several new finds in the century after 1730, it remained true that Scotland's lead ore deposits were small, dislocated and inaccessible.

Of the precious metals gold, again from the Leadhills/Wanlockhead area, failed to appear in anything but the smallest quantities. The El Dorado which had always been hoped for never quite materialised. Silver contributed little more but its occurrence in the Forth Basin, the heartland of Scotland's economy, made its exploitation easier, as did the proximity of the royal palace to the crushing and smelting mills at Linlithgow. Even these mines were, however, short lived and an attempt to re-establish the Linlithgow smelter in 1718 seems to have come to nothing⁵⁴.

More significant in the long term, though not in itself, was the discovery of a rich pocket of silver at Alva, near Stirling, which in the more hospitable political climate of Scotland after 1707, triggered off a new wave of mineral prospecting which was to bring to light hitherto unknown reserves.



- 1 : Carew, R. "Survey of Cornwall" London 1602 12
- 2 : Cochran-Patrick, R.W. "Early Records Relating to Mining in Scotland" Edinburgh 1878 xvi
Lythe, S.G.E. "The Economy of Scotland in its European Setting, 1550-1625" Edinburgh 1960 53
- 3 : Cochran-Patrick, op.cit., xxxv
- 4 : Ibid., xxxv
- 5 : Ibid., xviii
- 6 : Ibid., 40
- 7 : Ibid., 40-43
- 8 : RSSRS 1st Series 730-733
- 9 : Cochran-Patrick, op.cit., 45-47
- 10 : Ibid., 40-43
- 11 : GR's NT247747, NT264761
- 12 : Lythe, op.cit., 53
- 13 : Atkinson, S. "The Discoverie and Historie of the Gold Mynes of Scotland" (1619)
- 14 : RSSRS 1st Series VII 306
- 15 : Wilson, G. "Special Report on the Mineral Resources of Great Britain Vol XVII., Lead, Zinc, Copper & Nickel Ores of Scotland" Edinburgh 1921 15
- 16 : Atkinson, op.cit., 39
- 17 : RSSRS 1st Series, VII 346-7
- 18 : Lythe, op.cit., 54
- 19 : Cochran-Patrick, op.cit., xix
- 20 : Ibid., xxxviii
- 21 : RSSRS 1st Series, VII 306, 358
- 22 : Lythe, op.cit. 55-6

- 23 : In 1610 Primrose was licenced to make iron in Perthshire
(Cochran-Patrick, lviii); in 1616 he was granted a
monopoly of copper and lead mining on Islay, Mull,
Skye and Lewis.
- 24 : Cochran-Patrick, op.cit., xli
Wilson, op.cit., 66
- 25 : Chambers, R. "Domestic Annals of Scotland from the
Reformation to the Rebellion, 1745" Third Edition,
2 vols., Edinburgh 1874. I.412
- 26 : GR NS998778
SRO GD215/1825
Cochran-Patrick, op.cit., 142
- 27 : Lythe, op.cit., 56
- 28 : Cochran-Patrick, op.cit., 142, 148
- 29 : Ibid., xlii
- 30 : NLS Acc. 5381/46/f3
- 31 : SRO GD215/1825
- 32 : Cochran-Patrick, op.cit., lxiv
- 33 : Lythe, op.cit., 55
- 34 : Cochran-Patrick, op.cit., lxiv
- 35 : Ibid., xix
- 36 : Wilson, op.cit., 11
- 37 : Cochran-Patrick, op.cit., lv
- 38 : Hopetoun Lead Mining Papers No. 5 Class 1, 2/1, 2/2
- 39 : Smout, T.C., in Payne, P.L. (Ed.) "Studies in
Scottish Business History" London 1967. 104
- 40 : Ibid., 107
- 41 : Hopetoun Lead Mining Papers No. 5 Class 2, 22/8
(30th August 1694)

- 42 : Donnachie, I.L. "Scottish Windmills: an Outline and Inventory" PSAS XCVIII (1964-6) 295
- 43 : Wilson, op.cit., 11
- 44 : SRO GD45/26/132
- 45 : Smout, op.cit., 105
- 46 : Raistrick, A., & Jennings, B. "A History of Lead Mining in the Pennines" London 1965 117
- 47 : Ibid., 119
- 48 : SRO GD45/26/143
- 49 : Brown, J. "The History of Sanquhar" Dumfries, Edinburgh & Glasgow, 1891. 424
- 50 : Because of the complexity of company organisation, there is a distinct possibility that the two were part of the same company.
- 51 : Smout, op.cit., 106
- 52 : Brown, op.cit., 427-8. The wheel was installed on the Straitstep vein, on the north side of Wanlock Burn.
- 53 : Smout, op.cit., 107
- 54 : NLS Acc. 5381/46/f.3

CHAPTER SEVEN

WATER POWER IN THE IRON INDUSTRY

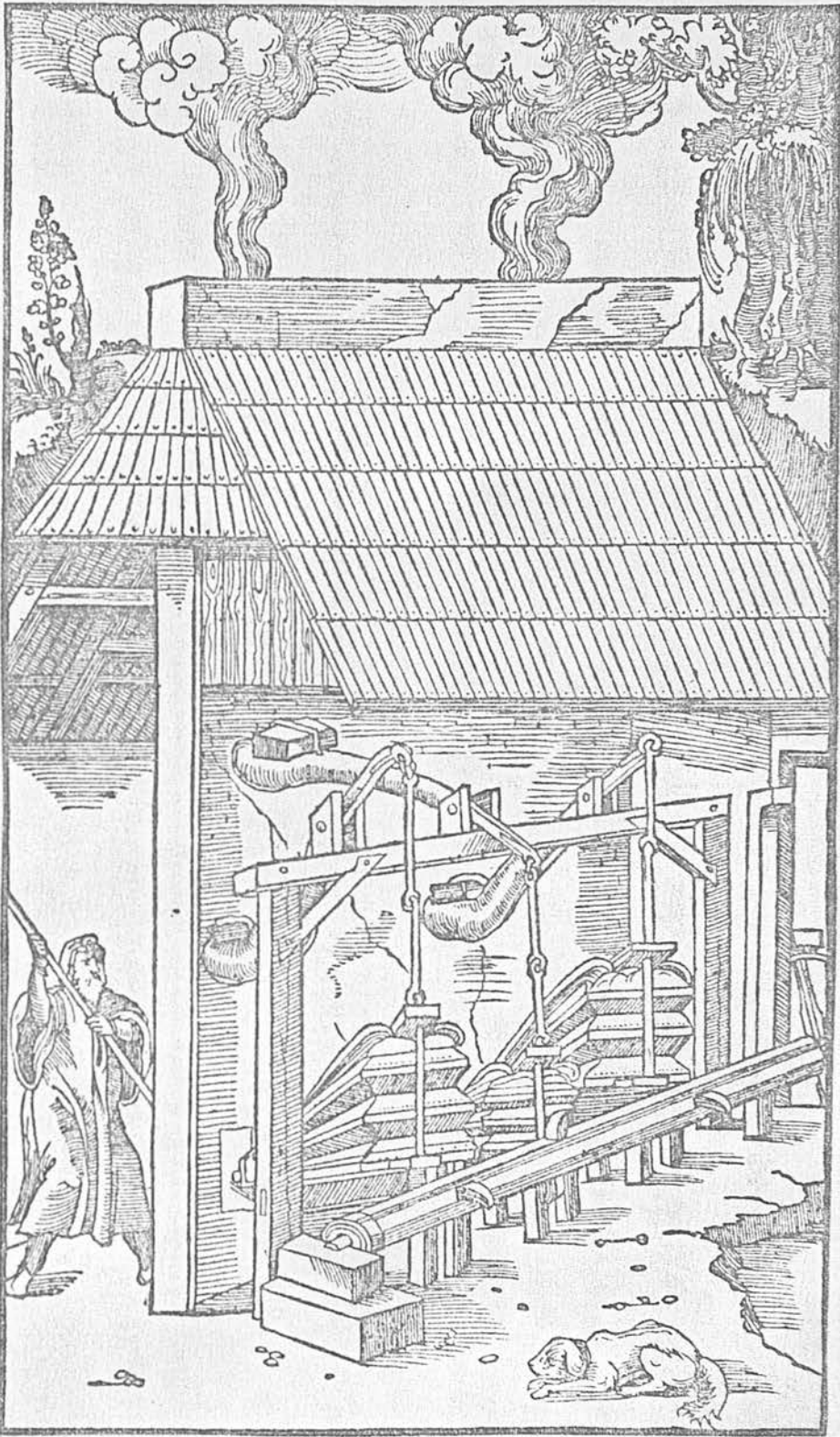
All too often the history of the Scottish iron industry is seen as having begun with the Highland iron smelters of the 18th century, or even later, with the establishment of the Carron Iron Works in 1759. Prior to 1730 however, several developments had taken place including the application of water power, and the industry had been established in both Highlands and Lowlands.

Technology

By 1730, two types of water-powered machinery had found their way into the Scottish iron industry: the blast furnace and the forge. The blast furnace was similar to the smelter used in the lead industry, employing an axle, fitted with cams or a crank to alternately raise and lower bellows, thereby increasing the available draught (figure 7.1). The forge, or trip hammer, used a principle similar to that employed by waulk mills and ore crushers, with a horizontally mounted lever or "hammer" fitted with a metal head, which was raised and dropped by cams on an axle (figure 7.2). Neither had achieved very widespread use in Scotland by 1730 (figure 7.3).

Background

Scattered across the Highlands were the small "bloomeries" which, using local bog ore and charcoal, produced poor quality iron. Sited on exposed hills or in narrow valleys, they could utilise natural air movements, and thereby achieve higher temperatures than would otherwise be avail-





7.3



able. Many sites have been located¹ but dating is difficult and in the present context they are of only marginal concern. Suffice to say that they were well enough established in north-west Stirlingshire by the late 15th century for rents there to be paid in iron and for an iron market to be held at Aberfoyle, at which locally produced iron could be exchanged for salt and other commodities². The second area in which the industry took root was around the Firth of Forth, only here activities were limited to the smithing, or forging of iron. By the second quarter of the 16th century, millocal coal was being used to "resolve and melt" iron, "which was therefore very useful and profitable for smiths"³. The proximity of coal was to be of great importance in the continuing presence of the industry in the area, as was the availability of charcoal wood for the Highland smelting industry. One use to which coal, exported to the Low Countries was applied, was the smithing of scrap iron, a commodity so abundant there that by the mid-16th century it was being carried as ballast on ships coming to Scotland to load coal and salt. The development of iron working industries such as the manufacture of girdles at Culross and nails at Dysart and St. Ninians, was closely linked, therefore, to other industrial developments in the area, notably the export orientated coal industry. So successful was the industry at Culross that in 1549, the smiths of that place signed a mutual document restricting the erection of additional forges and in 1599 they obtained a monopoly in girdle making; in 1663 the privilege was extended to cover smiths working on the Preston of Valleyfield estate

(vide infra p. 87) a favour possibly obtained through that family's links with the Bruce family⁴. Another industry which had benefitted from the growth of the coal industry was salt. Partly with a view to using up unsaleable small coals, salt pans were erected along the shores of the Forth estuary, from Thorntonloch in the south-east to Alloa on the north-west. At the same time however, the salt industry was also a consumer of iron, in the form of the iron plates with which salt pans were constructed. By 1573 there were thirty-eight salt pans between Prestonpans and Musselburgh, whilst Kirkcaldy had twenty-three⁵; such was the growth of industry and so inadequate the supply of metal plates that by 1574 the owners of salt pans were complaining of the dearth of iron⁶. It is hardly surprising therefore, that it was from the Forth basin that a new initiative was taken in the iron industry.

The Loch Maree Ironworks

In 1598 a group bearing the title "the Fife Adventurers" obtained from the Crown the right to colonise the Isle of Lewis but, through the combined efforts of the island's feuding chieftains, Mackenzie of Kintail and McLeod of the Lews, their attempts at settlement were defeated. In 1607 a further grant was made to one of the Adventurers, Sir James Spens of Wormistoun, to Lord Balmerino and Sir George Hay; they too failed, but in exchange for the group's rights in Lewis Hay and Spens accepted from Mackenzie of Kintail a cash payment plus the woods of Letterewe, which were to be used for iron smelting⁷.

This was in 1610; it is possible however, that Hay had been involved in ironmaking since 1607 at a site near Letterewe on the Lewis road⁸. The works which Hay founded were the first in Scotland to use the blast furnace and therefore the first to use water-power to provide an artificial draught. Trip hammers, also driven by water-power, may also have been used. To understand the origin of the works however, it is necessary to look at contemporary developments in England.

By the late 16th century the Weald, traditionally the centre of the English iron industry, was experiencing severe problems. One Ralph Hogge had been granted a patent for the casting of cannon there, but by 1573 it was apparent that many others, including the Queen herself, were ignoring it. In response to a complaint made by Hogge, the English Privy Council ordained that licences should be obtained from the Crown before anyone could make cannon; once a licence was obtained a record was to be kept of every piece cast and of each customer to whom they were delivered. In 1576 the casting of ordnance in the Weald was prohibited; similar measures were taken in 1579. In 1588 and 1589 production was again suppressed. Two years later, in an effort to stop exportation, bonds were taken from all furnace owners in the Weald and, in 1602, the Privy Council once more prohibited further casting. Whether or not they were effective, these measures, coupled with an already bad and worsening fuel situation, seem to have turned attention towards alternative sites⁹. Pressures appear to have been brought to bear on the Furness district of Lancashire and protective legislation had to be enacted

for that area too¹⁰.

At the time when Sir George Hay was setting up his Loch Maree iron works several Englishmen, skilled in iron-working, were in Scotland at the request of King James. Hay was on sufficiently close terms with the king to be allowed access to whatever knowledge these Englishmen might have brought with them. The validity of the assumption is strengthened by the presence of two Lancashire surnames, Kemp and Cross, in the Loch Maree area as late as the 19th century, for it is probably from the Furness district that Hay recruited his skilled labour. Some English capital may also have been employed: export of English cannon to Spain, by far the largest market, was either strictly controlled, or altogether prohibited. South Wales was well placed for illegally exporting cannon "because from that place very easilie they may be caried into Spayne"¹¹; how much better situated was Loch Maree, in an area outwith the jurisdiction of England and practically outwith that of Scotland too. Furthermore, English investment in Scotland was favoured by the relatively open financial and commercial relations between the two countries in the years immediately after the Union of 1603. In the absence of positive proof, however, the presence of English capital must remain a matter for conjecture.

Three iron furnaces, at Letterewe, Talladale and the Red Smithy, have been identified in connection with Sir George Hay. Quasi-archaeological examinations of these sites have revealed that the iron ore used was of three types: a locally obtained bog iron, red haematite (almost cer-

tainly from Cumbria) and clayband ironstone, probably from southern Scotland¹². The use of Cumbrian haematite ties in with the conjectured presence of English capital and identifies the Loch Maree group as precursor of various other charcoal ironworks erected in the Highlands to smelt English ores in the 18th century. The presence of clayband ironstone links these works with Hay's Fife interests.

The prospect of the further depletion of Scotland's limited timber reserves seems to have caused some concern in official quarters. The "Act anent the making of Yrne with Wode", 1609, in speaking of the Highlands, states that "some personis, vpoun advantage of the present generall obedience in those partis wald erect yrne milnis in the same pairtis, to the vtter waisting and consumeing of the saidis wodis". Under the Act, the making of iron with wood was prohibited, any iron thus produced being subject to confiscation. The working of the Act, if it was in fact implemented, had little effect on Hay's activities and in 1610 he obtained a gift of "the privilege of making of yron and glas workis within the Kingdome of Scotland"¹³. By 1613 it would seem that there was little that Hay could do wrong; according to a proclamation of that year, certain subjects had "interprysit the practise and making of yrne" and had at great expense "brought that work to ane ressonable good perfection of purpois and resolution". By this time Hay was shipping ore to his works from the Fife coast¹⁴ and, to protect this trade, it was ordered that no iron ore was to be exported from Scotland¹⁵. In 1620 Hay's works was still

using Fife ores shipped via St Monance¹⁶.

Besides producing cannon and other cast-iron goods for export Hay's works seem to have made bar iron, as is testified by the remains of water-powered forges¹⁷.

It is probable that some found its way to the Firth of Forth and it was almost certainly with this area in mind that, in 1621, contrary to existing laws, Hay was granted permission to transport his manufactured iron to any port or harbour of any burgh¹⁸.

The Limekilns Iron Mill

In 1622 Hay became High Chancellor of Scotland; his iron-making monopoly still had many years to run, and in his absence, the works probably continued to operate under a manager or factor¹⁹. Despite his retirement from smelting, Hay may still have been involved with the iron industry. The need for iron, already substantial in 1574 (p. 112above), must have been much greater by the 1620's and it is not surprising to find that by the early 1630's, an "iron mill" or forge had been established on the Fife coast, near Limekilns. Although it has been claimed that the mill was the creation of the Bruce family²⁰, Sibbald, writing in the 1700's when the mill was still working, states that it was, in fact, George Hay who had built it²¹. Two surviving papers relating to the mill throw a little light on its activities. According to Turner²² iron was extracted from local ore; the accounts for the period 1635 - 40 do not, however, bear this out for although the mill was using both Scots and Swedish iron the difference between the quantity of "gad iron" received

and iron work delivered* is not sufficiently great to be that between iron ore and pig or bar iron. Almost certainly the iron mill was a forge. During the period 1635-40 ironwork was being delivered at the rate of 15-20,000 stones per annum and although destinations are seldom noted, those that are, such as Kirkcaldy and Prestonpans, suggest that the salt industry with its great demand for iron plates was an important customer²³. Lythe points out that the Dutch were substantial buyers of Scottish salt and that, especially after 1622, direct exports to the Baltic were rising fast; were this the case, Swedish iron would furnish a useful return cargo. The scale and technical achievement of the salt industry in the mid-1630's is indicated by the observations of Sir William Brereton: at one salt works near Edinburgh, he saw iron evaporating pans eighteen feet long by nine feet broad - larger, he claimed, than the famous ones at Shields in England; and in expressing the number of pans along the Forth estuary, he spoke in terms of "infinite" and "innumerable"²⁴.

Besides the salt industry, the many small users of iron such as nail and griddle making, would offer a ready market for the iron mill's products. It is tempting to suggest that some of the iron used at the mill came from Hay's Loch Maree works, but in the absence of more positive proof, it must remain no more than a suggestion.

Later Furnaces and Forges

Little else is heard of water-power in the iron industry

* 9146 st 3 lb and 8025 st 10 lb respectively

prior to the 1720's. In 1634 there are references to a proposed iron works in Urquhart, Inverness-shire, including the right to make dams and water-courses. According to Mackay²⁵ iron was worked there, the ore being brought in from the south and the finished iron returned by the same route; apart from this, there is no indication that the works was ever built. In 1631, Sir John Grant of Grant agreed to enter into partnership with the purchaser of woods in Strathspey if ironstone was discovered and to share the cost of building an ironworks²⁶. McNair, in his "County of Angus in 1678", speaks of an iron smelter in the Wood of Dalbog, Edzell²⁷, and in the late 17th century Cameron of Locheil was said to be building an iron mill²⁸. In the absence of any other information, all these projects must be assumed to have been failures. Only in the early 18th century is anything heard of such ventures proving to be successful.

In April 1718 two Irishmen, John Smith and John Irvine, bought the woods of Inchcailloch on Loch Lomond-side and a division of the Menteith woods, to be cut in four and seven years respectively. The two partners were at liberty to make charcoal and to mine ore in Menteith and Buchanan, and were allowed to erect an iron mill with outbuildings, dams and lades²⁹. Whether or not they built an iron mill, the contract had been transferred to local interests by 1723 and an iron mill had been established at Achray in Aberfoyle parish, Perthshire. The mill appears to have used both scrap and ore, the former being imported via Port Glasgow and carried to the works on pack horses, while the latter came from the Fintry

district. Charcoal was made with timber cut from the extensive local birch woods. Besides its isolation, the mill faced other problems. In August 1723 when the manager, John Wilson, wrote to the partners, the payment of wages was so far behind that his life was endangered:

"I am very hopefull that you will relieve me out of this thraldome by speedy sending up of some mo(ne)y, for this unhappy crew are like to tear me in pieces"³⁰.

Work was frequently retarded by broken trip hammers, but despite the mill's isolation, labour troubles and mechanical failures, it was still operating in 1738, by which time it had gained a good reputation³¹. Although it is known that both bar and plate-iron were produced, little is known as to where these products were sent. One isolated reference speaks of plates being sent to Salt-coats in 1723 and it is tempting to see them as being used in salt pan construction there, but there is, yet again, no proof³².

Conclusion

With the exception of the works erected in the Highlands during the late 1720's, which will be considered in Chap.25 only one other site, a forge at Dalkeith, Midlothian, can be identified as existing before 1730³³. Few as these early sites may be, they represent the beginnings of an organised iron industry on a scale too great for bloomeries or smithing by hand; only by applying mechanical power could such a change be effected. The link had been established between Highland charcoal and Cumbrian ores, a link which was to last into the 19th century, with

water-powered ironworks situated close to fuel supplies. Closer to home markets water-power had also been applied to forging bar iron in response to the growing needs of coal, salt and other industries. Sales of coal and salt, particularly to overseas markets, benefitted the Scottish iron industry in more ways than one. The income which accrued from such sales, re-invested in these and other industries, tended to increase the demand for iron, while the ships that carried coal and salt from Scotland could bring back iron from the Baltic or scrap-iron from the Low Countries. It is no coincidence that between the 1560's and the 1630's Scottish imports of Baltic iron increased nearly fivefold³⁴. While Scotland had come nowhere near to achieving the status of England in the production of iron, a start had been made, so that with further growth in the century which followed, Scotland was able to surpass England in the technology, if not in the scale, of iron making.

- 1 : Macadam, W.I. "Notes on the Ancient Iron Industry in Scotland" PSAS XXI (1886-7)
- 2 : Turner, G. "The Ancient Iron Industry of Stirlingshire and Neighbourhood" Paper read to the Stirlingshire Natural History and Archaeological Society, 20th November, 1910. 9-10
- 3 : Ibid., 10
- 4 : Ibid., 10-11
- 5 : RSSRS, 1st Series, II 263, 296
- 6 : APS III 93b. The salt masters also complained of the shortage of coal and horsemeat.
- 7 : Macadam, op.cit., 110
Dixon, J.H. "Gairloch" Glasgow (1886) 77
- 8 : Dixon, op.cit., 78
- 9 : Ashton, T.S. "Iron and Steel in the Industrial Revolution" Manchester 1924 5-9
- 10 : Ibid., 9
- 11 : Ibid., 8
- 12 : Dixon, op.cit., 89
Macadam, op.cit., 109-123
- 13 : Macadam, op.cit., 111
- 14 : Turner, op.cit., 11
- 15 : Cochran-Patrick, R.N. "Early Records relating to Mining in Scotland" Edinburgh 1878. 162
- 16 : RSSRS 1st Series, XII 187
- 17 : Macadam, op.cit., 122-123
- 18 : Ibid., 89
- 19 : Dixon, op.cit., 82
- 20 : Turner, op.cit., 13

- 21 : Sibbald, R. "History of Fife and Kinross" (1710) Edinburgh 1803. 299
- 22 : Turner, op.cit., 13
- 23 : SRO GD15/898/1 - 2
- 24 : Lythe, S.G.E. "The Economy of Scotland in its European Setting 1550 - 1625" Edinburgh, 1960 51
- 25 : Mackay, W. "Urquhart & Glenmoriston" Inverness, 1893 451
- 26 : Lindsay, J.M. "The Use of Woodland in Argyllshire and Perthshire between 1650 and 1850" Edinburgh PhD Thesis 1974
- 27 : McNair, J. "County of Angus in 1678" (1883) Cited by Lindsay, op.cit., 565
- 28 : Mitchell, Sir A. (Ed.) "Macfarlane's Geographical Collections" SHS LI (1906), LII (1907), LIII (1908) LI. 51-5
- 29 : Lindsay, op.cit., 567
- 30 : SRO RH15/120/91
- 31 : Taylor, op.cit., 15
- 32 : SRO RH15/120/91
- 33 : SRO GD 224/282/1 1720
- 34 : Lythe, op.cit., 62

CHAPTER EIGHT

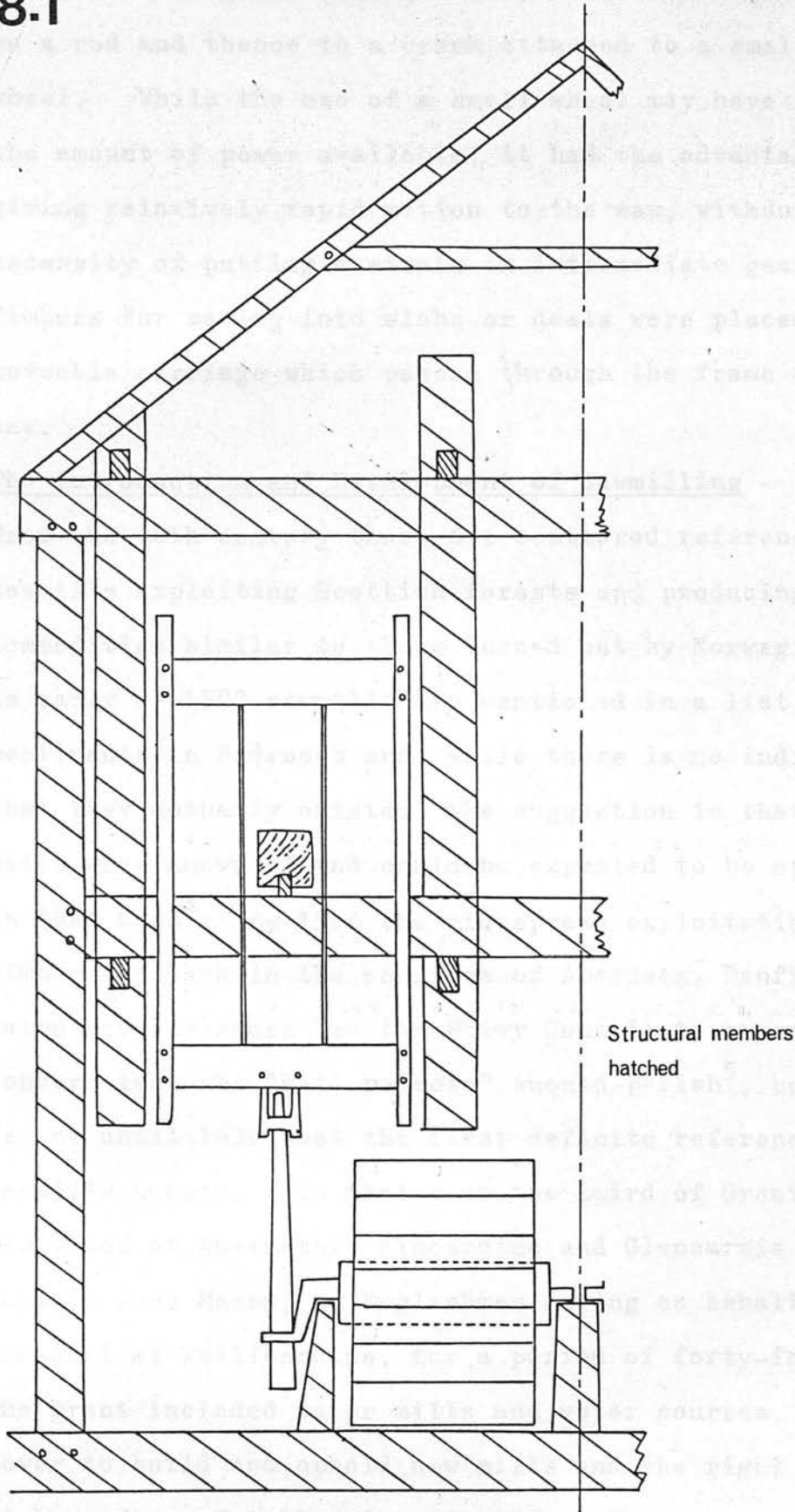
SAWMILLS

By the mid 16th century most of the great Caledonian Forest had been cleared from the Lowlands of Scotland and while a few remnants such as Presmennan Wood, East Lothian, still survived, the scarcity of good stands of timber close to centres of population was such that most of Scotland's timber requirements were met from Norway. By making use of water-powered sawmills Norway had been able to exploit its substantial forests to produce much greater quantities of squared timber than could be prepared by handsaw and axe¹: by 1688 there were about 650 such mills in Southern Norway, each turning out about 7,500 deals per annum². In the Scottish Highlands there was still much timber as yet unexploited, but one person speaking of Angus in 1678 pointed out that dependence on Norwegian timber was due not so much to the lack of timber in Scotland, but rather to the "rugged and impassable rocks which prevent its being transported from the places where it grows"³. The transportation of Norwegian timber to Scotland's east coast presented relatively few problems.

Technology

From contemporary European illustrations and from Scottish examples of the later 18th century, it would appear that the sawmills established in Scotland during this period used heavy frame saws. Figure 8.1 shows a sawmill built at Fochabers, Moray, c. 1750, but is probably similar enough to earlier examples to serve as an illustration. The frame which carried the saw is mounted vertically between two

8.1



Structural members
hatched

runners which guide its movement. The frame is connected to a rod and thence to a crank attached to a small water wheel. While the use of a small wheel may have reduced the amount of power available, it had the advantage of giving relatively rapid motion to the saw, without the necessity of putting a strain on intermediate gearing. Timbers for sawing into slabs or deals were placed on a moveable carriage which passed through the frame of the saw.

The Introduction and Development of Sawmilling

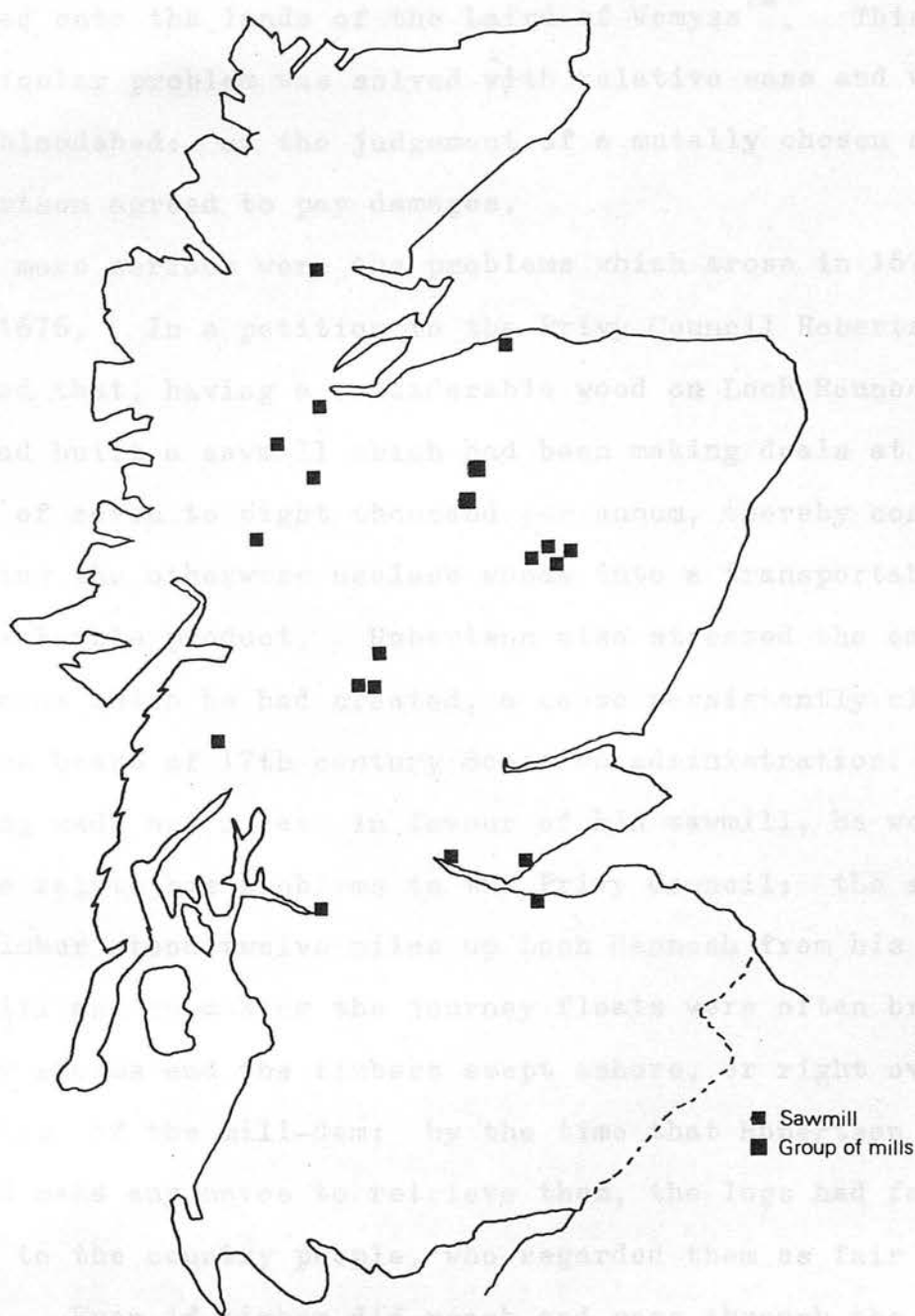
From the 16th century there are scattered references to sawmills exploiting Scottish forests and producing commodities similar to those turned out by Norwegian mills. As early as 1502 sawmills are mentioned in a list of pertinents in Badenoch and, while there is no indication that they actually existed, the suggestion is that such mills were known of and could be expected to be operating in that area⁴. By 1564 the widespread exploitation of timber and bark in the counties of Aberdeen, Banff, Moray, Nairn and Inverness led the Privy Council to express concern lest the "hail polecie" should perish⁵, but it is not until 1630 that the first definite reference to sawmills occurs. In that year the Laird of Grant let his woods of Abernethy, Kincardine and Glencarnie to Captain John Mason, an Englishman acting on behalf of the Earl of Tullibardine, for a period of forty-four years. The grant included water mills and water courses, with power to build and uphold new mills and the right to float timber, free of tolls, down the River Spey to the sea.

For these privileges and the use of the woods, Mason paid £20,000 Scots⁶. A mill at Nether Inver, Glenmoriston, is referred to in 1643⁷, one at Rothiemurchus in 1650⁸ and one at Invercharon, Ross-shire, in 1652⁹ (figure 8.2). By the 1680's sawmills are also known to have existed in Glenmore¹⁰ and at Rothiemurchus, both in Badenoch. It is hardly surprising to find that it was the woods of the eastern Highlands which saw the first use of sawmills, for while the area was not as yet totally subjugated by the Crown, it was at least more stable than the west and more open to outside influences; once landowners became aware of and interested in the commercial potential of their woods, safe working conditions were all the more likely to exist. Furthermore, access to the sea and then to east coast markets could be obtained either by river or loch, as in the case of the Badenoch or Glenmoriston Sawmills, or directly, as at Invercharon. Similar developments took place on Deeside, Aberdeen-shire. A charter dated 1638 reserves the liberty to build "an saw water miln or a saw windmiln"¹². From the mention of wind-powered sawmills it would appear that this still relatively new piece of Dutch technology had already reached Scotland by the 1630's¹³. At the mouth of Glenquaich, also on Deeside, a sawmill was built in 1695. Figure 4.2 shows the distribution of water-powered sawmills in Scotland between 1550 and 1730.

Two Perthshire Examples

The best documented mills and those which best illustrate the problems of exploiting Highland timber are those which

8.2



were set up in Rannoch and Glenlyon, on the upper tributaries of the Tay. At some time prior to 1661, Alexander Robertson of Strowan had constructed corn, saw and waulk mills, all under the same roof, at Kinlochrannoch. Unfortunately, the damhead on the mouth of Loch Rannoch held back the loch's waters to such an extent that they overflowed onto the lands of the Laird of Wemyss¹⁴. This particular problem was solved with relative ease and without bloodshed: on the judgement of a mutually chosen arbiter Robertson agreed to pay damages.

Much more serious were the problems which arose in 1675 and 1676. In a petition to the Privy Council Robertson stated that, having a considerable wood on Loch Rannoch, he had built a sawmill which had been making deals at the rate of seven to eight thousand per annum, thereby converting the otherwise useless woods into a transportable and saleable product. Robertson also stressed the employment which he had created, a cause persistently close to the heart of 17th century Scottish administration.

Having made out a case in favour of his sawmill, he went on to relate his problems to the Privy Council: the stands of timber stood twelve miles up Loch Rannoch from his sawmill and in making the journey floats were often broken up by storms and the timbers swept ashore, or right over the top of the mill-dam; by the time that Robertson could make any moves to retrieve them, the logs had fallen prey to the country people, who regarded them as fair game. Even if timber did reach and pass through the mill, there was a possibility that the deals cut from

it would disappear during the night¹⁵. The following year Robertson's problems came to a head. The mill had been built on his own land but, being surrounded by the lands of the Marquis of Atholl, it was only with the latter's grudging consent that Robertson had been able to build a damhead. The Marquis's enthusiasm for the mill apparently continued to cool and in 1676 he sent his factor and a band of four hundred* armed men to demolish the dam. Robertson's appeals to the Privy Council brought only confirmation of Atholl's right to do so¹⁶. As a result of this incident the sawmill was moved to Carrie, on the south side of Loch Rannoch where a mill could be powered by the Allt na Bogair. By 1683, by his own estimates, Robertson had made 176,000 deals there and in the same year, by obtaining the right to oversee the highways from Carrie to Apnadull (Appin of Dull) and from his sawmills to St John's Town (Perth), he was able to ease the awkward problem of transporting them to lowland markets¹⁷. Robertson's woods seem to have been more than adequate for the demands of his sawmill, and extraction continued into the 18th century: in 1720 the mill was being let at £125 Sterling per annum¹⁸ and by 1750 two mills were in use¹⁹.

The Glenlyon sawmills also had their problems. Like Robertson of Strowan, Campbell of Glenlyon, the owner of the woods being exploited, was losing quantities of floated timber to the local inhabitants and in 1672 he

* Robertson's own, possibly exaggerated, estimate.

too turned to the Privy Council for help²⁰. Although there is no conclusive evidence of there having been a sawmill at this stage, the inclusion of deals among the items being floated certainly points to there being one. In 1675 or thereabouts, Campbell entered into a contract with one Captain John Crawford, setting to him for 21 years the whole fir woods (probably Scots pine) on the Glenlyon estate with power to use the existing sawmill²¹, or to build new mills. Crawford was free to use whatever ground he needed for workmen's houses and to dam up the River Lyon at any point for the purposes of the mill. For the first three years the agreement worked well; Crawford paid the yearly tack duty and started to cut a lade through rock to serve a new mill, probably on the River Lyon²². Work on the lade was nearing completion when, it was claimed, a band of men led by Campbell himself appeared on the site, stole tools and threatened the workers, who eventually fled. Either before, or shortly after this time, the original lessee died and the lease was taken over by Patrick Stewart of Ballachen. In a complaint to the Privy Council he claimed that Campbell, accompanied by the usual band of armed men, had turned up again on 1st August 1678 and carried off the saw, various tools, three hundred deals and a thousand great trees ready for market. A year later to the day Campbell appeared yet again, this time to occupy the sawmill. From the defence which he gave, it would appear that Campbell was more than a little perturbed by the rate at which Stewart was extracting timber: between April and July.

1678 he was said to have cut down no less than eight thousand fir trees, a very large number considering the already small extent of the woods. Furthermore, whether or not Campbell had foreseen it at the time of granting licence, the damming of the River Lyon had damaged his salmon fisheries, a valuable asset on a Highland estate. The Privy Council found that Stewart had been wrongfully dispossessed, but in view of the difficulties of occupying such a tenancy in the Highlands against the will of the landowner, it is unlikely that Stewart returned for long, if at all²³.

The Early Eighteenth Century

Despite the rebellion of 1715 the early post-union years seem to have provided an environment more conducive to the exploitation of the Highland forest than that of the 17th century. The English navy needed large quantities of timber and other naval stores and it was with a view to obtaining these from British territories that, during the reign of Queen Anne, Acts were passed encouraging the importation of naval stores from America and from Scotland. According to the latter Act there was, in Scotland, a great store of pine and fir trees fit for masts and for making pitch and tar, but mostly in remote, mountainous places, away from navigable rivers. To encourage the proprietors of such woods to make roads by which timber might be extracted, premiums were offered for tar, pitch and turpentine, masts, yards and bowsprits, on condition that these products were transported from Scotland to England, and in British ships²⁴. Significantly, a copy of the Act is to be found among

the papers of the Duke of Gordon, who owned the Woods of Glenmore, Inverness-shire. There had been a sawmill in Glenmore in the late 17th century and in 1712 the Duke engaged one John Brander, a millwright. Brander, who had already built sawmills above Loch Morlich in Glenmore and at Fochabers, was to oversee the Glenmore sawmill operations for a three-year period. To facilitate the floating of timber down the Water of Luineag to the Spey, a dam and sluice were constructed on Loch Morlich under the supervision of John Smith from Leith. The following year the burn was cleared to facilitate floating operations. John Brander also seems to have been responsible for a short-lived mill which the Duke of Gordon operated on Rothiemurchus lands, at Slianaman or Struahamain; after the mill was abandoned the lands were resumed by Grant of Rothiemurchus. A third mill was built below Loch Morlich, apparently at Ardrum, which also lay on Rothiemurchus lands. This mill, on the Water of Luineag, was the work of a Mr. Gage, an Englishman who had a lease of the woods from the Duke of Gordon, some time before 1715. By that year Mr. Gage had completed one sawmill and was contemplating another, but having joined in the '15 on the losing side, he had to give up his sawmilling activities and one by one his twelve or so workers also left. Between 1715 and 1718 the Duke took direct control of the sawmill; a wagon road from the woods to Torgarve, on Speyside, dates from this period if not before. In 1718 the woods were again let, this time to Smith and Francis, two Englishmen, who worked them for a further

three years. At the termination of their lease the Duke once again took personal charge, but gave up the sawmill as unprofitable in 1725²⁵.

The interest shown in the woods by both English speculators and Scottish landowners, indicates an attempt to benefit from the Scottish Timber Act by exploiting these isolated woods. The woods on Deeside were also attracting attention: in the early 18th century sawmills operated at Invercauld, Prony and Glenlui²⁶. In 1725 the Wood of Derry was estimated to contain enough timber to keep a sawmill going for five or six years, or enough for a ten-year bargain if put up for sale. The eleven thousand trees in the wood were each valued at 10s. Scots; a sawmill could be erected for 400 Merks (£266 13s 6d Scots) exclusive of the digging of lades, which could be done by the laird's own tenants. Once built, the mill could be expected to manufacture between seven and eight thousand deals per annum²⁷. The Glenlui mill, built about that time, may well have been the one in question. Production figures for 1728 show that in that year three thousand and fifty-one broad deals, nine hundred and seventy-four narrow deals and one thousand three hundred and forty-four backs were sold, mostly in small batches of six to twenty-four, though occasionally sixty or a hundred and twenty were sold at a time. Although the Glenlui mill, unlike those of Badenoch, depended on local markets the profits made were adequate, rising from £323 16s 8d Scots in 1725 and 1726 to £1076 18s 6d Scots in 1728 and £1467 15s 6d in 1729²⁸.

Lowland Sawmills

For all the effort put into exploiting Scotland's remaining forests, the quantities of timber extracted were generally small and the returns short-lived. In the burghs of Lowland Scotland timber from overseas continued to dominate the supply, with coastal sawmills long established at Burntisland²⁹, Alloa³⁰, Leith³¹ and Airth³², the last two mills being wind-powered. With the Union of 1707, the huge timber resources of the New World had also become accessible to Scottish merchants and the establishment of a sawmill at Glasgow in the 1720's was probably aimed at exploiting this new source³³. During the century after 1730 however, the landscape of Lowland Scotland was to change in a way which stimulated Scottish timber production, while those few woods left in the Highlands remained adequate for the needs of those who continued to exploit them.

(Eds) "A History of Technology". 3 vols

1954-59 III, 106-7

1954-59 IV, 106-7

1954-59 V, 106-7

1954-59 VI, 106-7

1954-59 VII, 106-7

1954-59 VIII, 106-7

1954-59 IX, 106-7

1954-59 X, 106-7

1954-59 XI, 106-7

1954-59 XII, 106-7

1954-59 XIII, 106-7

1954-59 XIV, 106-7

- 1 : Lythe, S.G.E. "The Economy of Scotland in its European Setting 1550-1625" Edinburgh 1960 148
- 2 : Anderson, M.L. "A History of Scottish Forestry" 2 vols London, 1967 I 331
- 3 : Ibid., I. 317
- 4 : In listing pertinents it was customary to list any item which might possibly be present. SRO GD176/19
- 5 : RSSRS 1st Series, 279-80
- 6 : Anderson, op.cit., I.321
- 7 : RSSRS 2nd Series, IX 1468 (1643)
- 8 : Anderson, op.cit., I 359
- 9 : RSSRS 2nd Series, X 17
- 10 : SRO GD44/51/742
- 11 : Anderson, op.cit., I.322
- 12 : "Records of A boyne" New Spalding Club. 1894 291
- 13 : Wailes, R. in Singer., Holmyard, E.J., Hall, A.R. & Willis, T.I. (Eds) "A History of Technology" 5 vols Oxford, 1956-59 III. 106-7
- 14 : SRO GD1/389/8
- 15 : RSSRS 3rd Series, IV 421
- 16 : RSSRS 3rd Series, IV 570-76
- 17 : RSSRS 3rd Series, VIII 148
- 18 : SRO GD50/160
- 19 : Anderson, op.cit., I.446
- 20 : RSSRS 3rd Series, III.448
- 21 : Probably at Milton Eonan (GR NN5746):
Stewart, A. "A Highland Parish or the History of Fortingall" Glasgow 1928. 92
- 22 : Stewart, op.cit., 92

- 23 : RSSRS 3rd Series, VII 46-7
- 24 : SRO GD44/39/27
- 25 : SRO GD44/19/25
- 26 : SRO GD124/17/147
SRO GD124/17/123
- 27 : SRO GD124/17/123
- 28 : SRO GD124/17/144
- 29 : See Chapter 1 p. 9
- 30 : Mitchell, Sir A. (Ed.) "Macfarlane's Geographical Collections" SHS LI (1906), LII (1907), LIII (1900)
I.308 (1722): Two mills on the Brathie Burn near the coast.
- 31 : Anderson, op.cit., I.331
- 32 : Mitchell, op.cit., I327. A sawmill in the village, "which goes by wind of a figure never before seen in Scotland".
- 33 : SBRS "Extracts from the Records of the Burgh of Glasgow" V (1718-38), Glasgow, 1909. 152, 256, 349

THE TECHNOLOGY OF WATER POWER 1730 - 1830Introduction

The early stages of the Industrial Revolution have usually been described as the Age of Water Power¹, for despite the application of the steam engine to rotary motion during the late 18th century, water power was already being harnessed for a wide range of industrial uses and the subject of technical innovation well into the 19th century. Indeed, new techniques for utilizing water power brought about a renaissance in its use during the late 18th century. Almost all of the new manufacturing techniques developed between 1730 and 1830 in the textile industry, for example, required water power for their development. The water power of the late 18th century was not only more efficient than the water power of the 17th century, but it was also more flexible. The water power of the late 18th century was not only more efficient than the water power of the 17th century, but it was also more flexible. The water power of the late 18th century was not only more efficient than the water power of the 17th century, but it was also more flexible.

1730 - 1830

Water Power in the 18th Century

During the 18th century the demands of a wide range of manufacturing industries brought the trade of millwrights to a new prominence. The millwright was the craftsman who designed and built the water wheels and mill races which were used to generate power for the mills. The work of the millwright was not only a technical one, but it was also a business one. The millwright had to be able to estimate the cost of his work and to negotiate with the mill owner for the best price. The work of the millwright was not only a technical one, but it was also a business one. The millwright had to be able to estimate the cost of his work and to negotiate with the mill owner for the best price. The work of the millwright was not only a technical one, but it was also a business one. The millwright had to be able to estimate the cost of his work and to negotiate with the mill owner for the best price.

THE TECHNOLOGY OF WATER POWER 1730 - 1830Introduction

The early stages of the Industrial Revolution have accurately been described as the Age of Water Power¹, for despite the application of the steam engine to rotary motion during the late 18th century, water power was already being harnessed for a wide range of industries and was the subject of further design innovations well into the 19th century. Indeed, new techniques for utilising water power brought about a minor renaissance in its use during the late 19th century. Almost all of the new manufacturing techniques which appeared between 1730 and 1830 in the textile industry, in iron-working and in a multiplicity of other trades, made use of the tried and tested power of water before attempting to use steam power. The nature of these applications will be considered in the chapters which follow.

Millwrights and Engineers

During the 18th century the demands of a wide range of manufacturing industries brought the trade of millwright into its own and helped to give birth to the profession of engineer. The work of Smith at Deanston and Kelly at New Lanark, both in connection with the cotton industry, is dealt with in chapter twenty, but the virtuosity and prowess of the Scottish millwright is best illustrated by the Meikle family who, through three generations, come close to covering the entire period. James Meikle has already been referred to in connection

with the introduction from Holland of winnowing machines and pot-barley mills². Of his sons, Andrew (1719-1811) is well known for his threshing machine patent³, but this has tended to overshadow his other achievements and those of another member of the Meikle family, Robert. The exact relationship of Robert to Andrew and to James Meikle is not clear, although it seems likely that he was Andrew's elder brother. In 1734 he turns up in Glasgow as a "stranger millwright", already familiar with iron-rolling and -slitting machinery, and having a knowledge of surveying and model-making⁴. After settling in Glasgow as a "wright and engine maker"⁵ he produced plans and models of a number of mills for the Duke of Argyll during the mid-1740's⁶. From about 1747 to about 1768 Robert and Andrew Meikle worked together on a number of projects, mostly in connection with the textile industry. A long association with the Board of Trustees for Manufactures started in 1747 with visits to bleachfields in the Perth area;⁷ in 1751 they were taken on as consultant millwrights to the Board and were given £20 per annum to train apprentices⁸. Together they developed improved bleaching machinery in 1754⁹. Each carried out surveys of mills for the Forfeited Estates Commission¹⁰ and in 1768 they took out a joint patent on corn-dressing machinery¹¹. Robert is also identified with a number of engineering projects, starting in 1767 with a joint survey with Watt for the proposed Forth and Clyde Canal, using a route shorter than that proposed by Smeaton¹². At this time he was resident at Westfield, Falkirk. Thereafter his work seems to have taken him back to the west

of Scotland. His name appears in connection with "engines" for Port Glasgow dry dock (1768), a scheme for deepening the Clyde (1778) and additions to the old Glasgow Bridge (1779). Robert Meikle died in 1780, by which time he seems to have returned to Saltoun Barley Mill¹³. Had he been born some fifty or so years later, Robert Meikle might have found fame as an engineer: his later work in particular shows a range of skills far beyond those of millwright and it is interesting to note that in the 1768 patent Andrew is identified as "Millwright" but Robert as "Engineer"¹⁴. As it was, Robert has been almost completely forgotten, overshadowed by the later achievements of Andrew. Although he travelled widely in Scotland and in England, Andrew Meikle, unlike Robert, was based in his native East Lothian throughout his long life. Up to about 1750 his address is given as Saltoun, from then until about 1783 as Houston Mill, East Linton, and for the rest of his life as Knowes Mill, East Linton¹⁵. Despite his "great throng of work"¹⁶ he could still find time to perform work locally, free of charge; that such generosity did not go unrecognised is evident from a minute of Haddington Town Council, dated 28th June 1763:

"The Council, in regard Andrew Meikle, milnwright at Houston Waukmiln, has upon several occasions done acts of friendship to this Burgh by his advice in repairing the Town's Milns, and that without demanding any gratuity for his trouble, recommend to the Dean of Guild and his Council to admit the said Andrew Meikle ane heritable Burgess upon the town's expense"¹⁷.

Andrew's second patent, for spring-regulated windmill sails

was taken out in 1772, but its originality has since been contested on the basis of an earlier patent (1745) to Edmund Lee¹⁸. Work on the threshing machine started in 1776¹⁹ and in 1781 he designed a new set of mills for the Burgh of Dumfries, to replace Smeaton's mills which had been lately destroyed by fire²⁰. From about 1785 Andrew worked closely with his son George: together they designed a mill for the Burgh of Linlithgow²¹ and the threshing machine patent of 1788 was taken out in their joint names²². The originality of the machine was disputed at the time and widely "pirated" although towards the end of Meikle's life a subscription was raised for him in recognition of his work²³. From 1790 until his death in 1812 less is heard of him, though it would be wrong to assume that he drifted into senility: evidence given at a Court of Session case in 1805 suggests that, even in his mid-eighties, he still had possession of his faculties²⁴. It was George Meikle who erected the first commercial model of the threshing machine at Kilbagie, Clackmannanshire, but he is best remembered for his ingenious water-raising wheel at Blairdrummond (1787) Stirlingshire, the sophistication of which drew praise from various quarters, including the designer of an alternative but less efficient wheel²⁵. George died in 1811, shortly before his father. A summary of the Meikles' work appears in Appendix D. The Meikles also provide a link with the engineering profession in the person of John Rennie. Rennie was born on 7th June 1761, the son of James Rennie, farmer at Phantassie, only a stone's throw from Houston Mill. According to Boucher²⁶, Rennie often played truant and visited Meikle.

At the age of twelve, having completed his local education, he spent two years working with Andrew Meikle prior to going to school at Dunbar in 1775 at his own request, to learn Latin, English and Mathematics. On a visit to Dunbar, David Loch commented on Rennie's remarkable abilities; after two years at school, Rennie returned to working with Meikle, continuing his studies in his spare time. Starting with a few jobs which Meikle had insufficient time to undertake, Rennie soon became an accomplished millwright. According to tradition, his first job in 1779 was to install a threshing machine at Knowes Mill, followed by machinery for mills at Invergowrie (Dundee) and Bonnington (Edinburgh)²⁷. Rennie's notebook, now in the National Library of Scotland, includes a series of experiments on a flour mill at Invergowrie (1782), the content of which shows that his skills as a millwright already had a firm scientific basis²⁸.

In November 1780 Rennie had started three years of study at Edinburgh University under the eminent Professor of Natural Philosophy, John Robison, a man who also took a scientific interest in water power²⁹. It was Robison who recommended Rennie to Watt as a suitable person to carry out the structural and millwrighting-work on the Albion Mills, London (1784), the first of many steam-powered mills³⁰. Rennie's contribution to the technology of water power will be discussed further at a later stage; a summary of his most important Scottish works appears in Appendix E.

The continuing importance of water power is reflected in the work of major engineering figures, such as Telford,

Smeaton and Fairbairn³¹; of these the most important was Smeaton, whose "Experimental Enquiry Concerning the Natural Powers of Water and Wind to Turn Mills..." brought him the Royal Society's Gold Medal. Using ingeniously designed testing apparatus, first with paddles (undershot) then with buckets (overshot), (figure 9.1) Smeaton was able to show that the best design of overshot wheel was considerably more efficient than the best undershot type³². On the basis of this he established the principle that there must be considerable losses in efficiency when a jet of water strikes the flat blade of an undershot wheel and that the work could be much better done by filling the buckets of an overshot wheel and relying on gravity rather than on impulse alone³³. Being not only a man of science but also a practical working engineer, Smeaton was able to put his theories into practice at a number of sites. A summary of Smeaton's work in Scotland appears in Appendix F. Without doubt, therefore, and notwithstanding the attention devoted to the development of the steam engine between 1730 and 1830, a considerable amount of attention was still being paid to technical improvements in water-driven prime movers, by a number of parties from practical millwrights to the most eminent engineers and academics of the age. The rest of the chapter will be given over to describing the nature of these improvements and the way in which they were put into practice in Scotland.

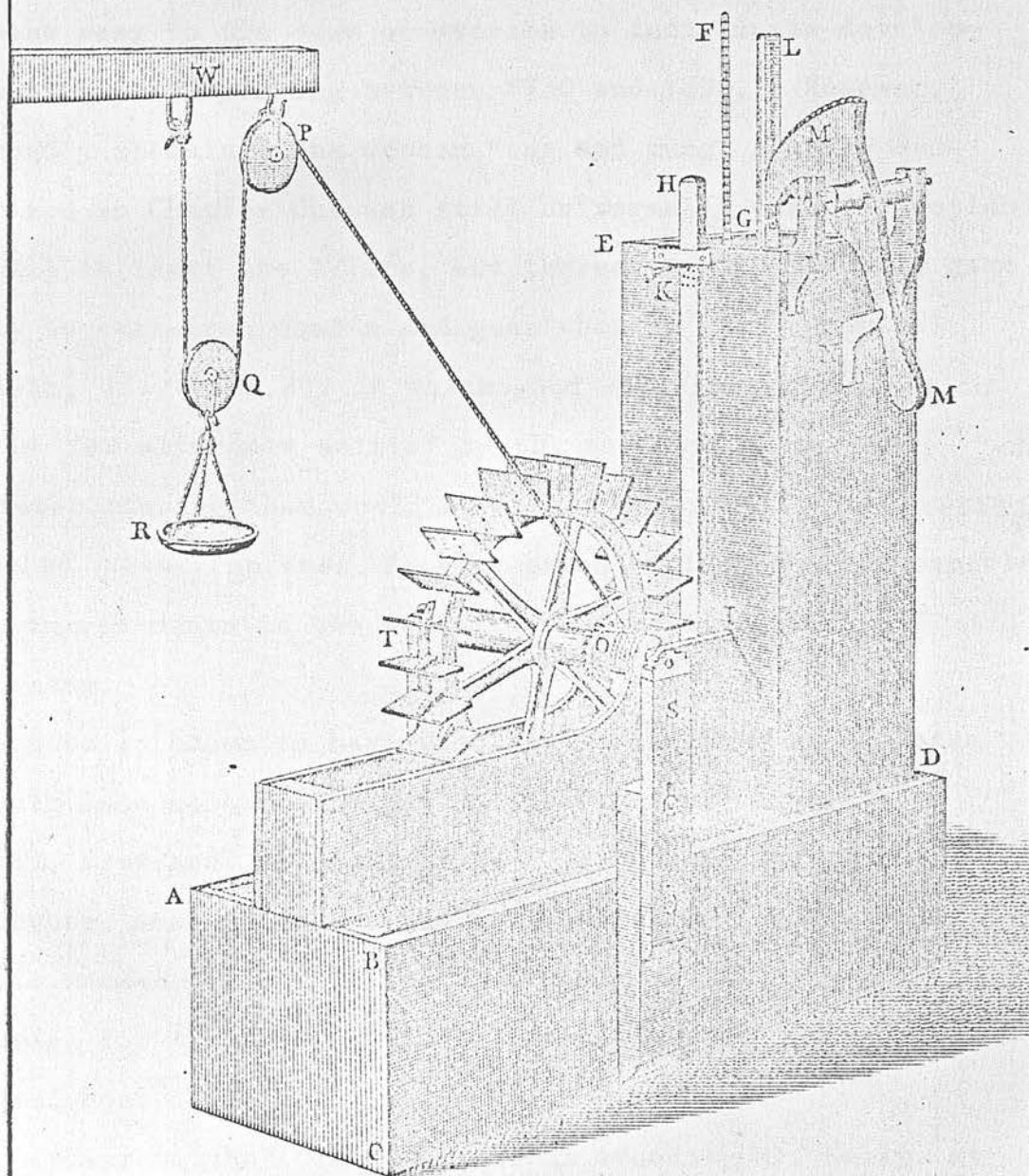
Mill Gearing

In terms of materials, the Industrial Revolution is characterised by a move from organic to inorganic materials or,

9.1

Plate 4. page 27.

Philos. Trans. Vol. LI. TAB. IV



Greater delin.

more specifically, from wood to cast iron. This transition is clearly illustrated by developments in water mill machinery which underwent changes not only in materials but also, as a result, in design.

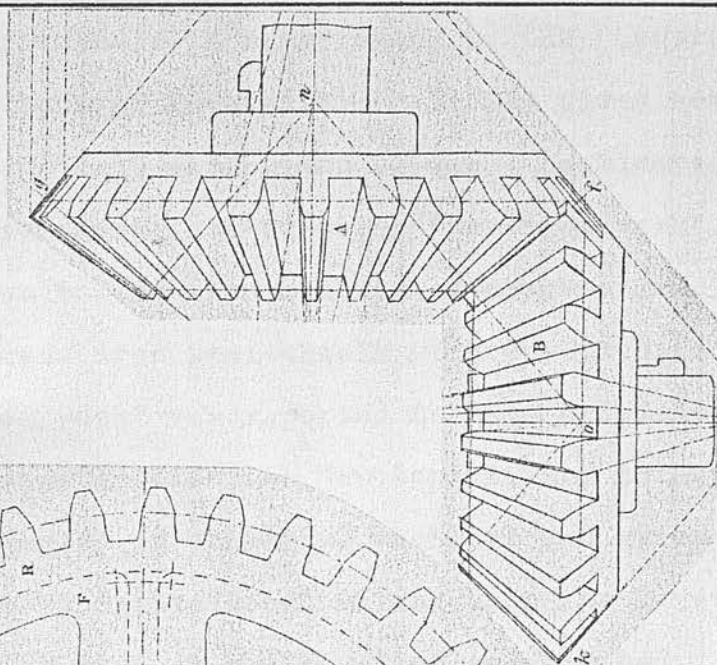
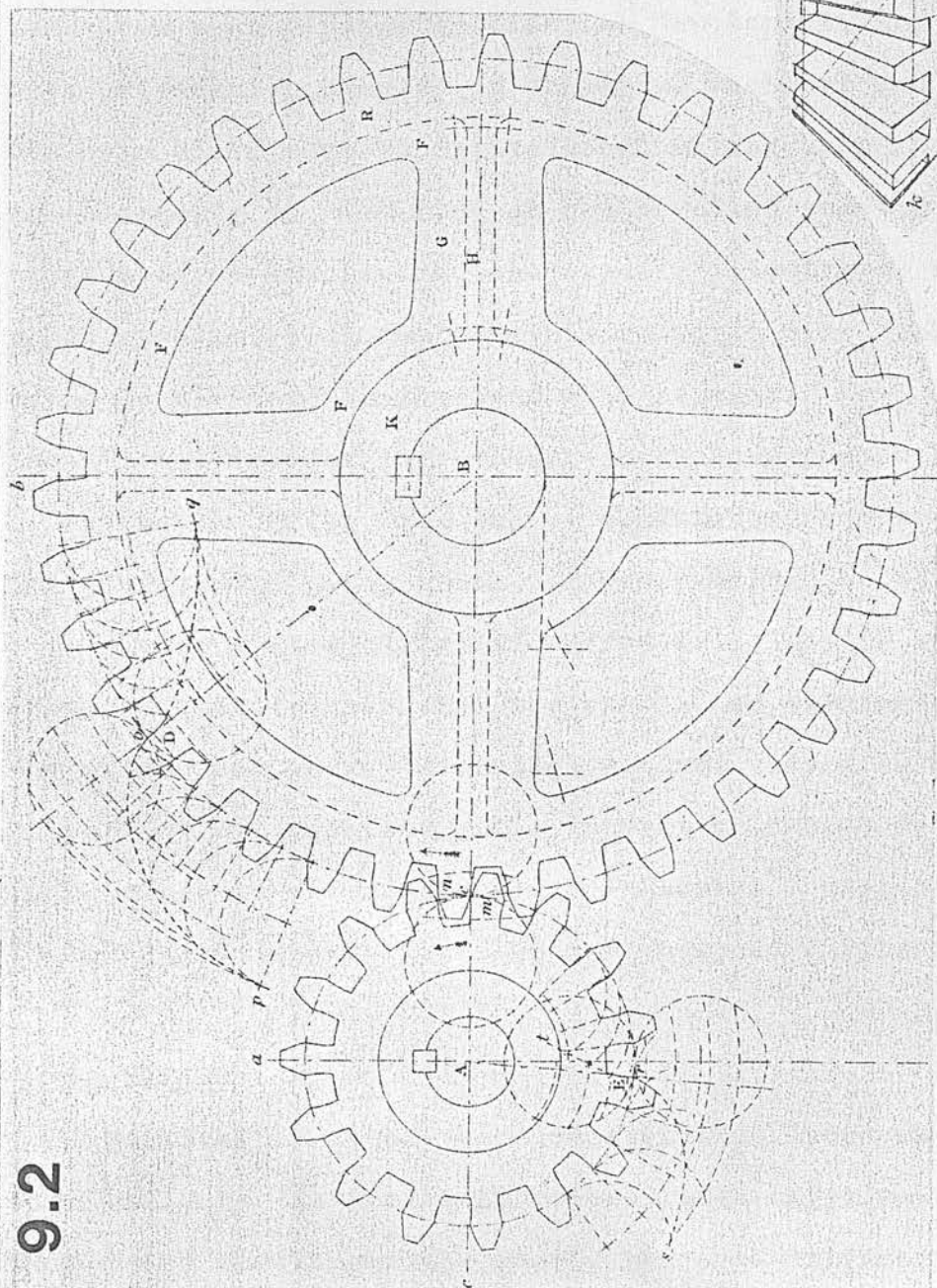
As so little has been written on the subject, it is by no means easy to tie down or ascribe to individuals developments in mill gearing between 1730 and 1830. However, broadly speaking, the wooden "cog and rung" gearing described in Chapter One was still universally used in Scotland until at least the 1770's, but thereafter it gradually gave way to cast-iron shafts and gear wheels, with cycloidal teeth, (figure 9.2), in which wood was used only occasionally for alternate sets of teeth, to provide smoother, quieter running than would have been possible if iron teeth meshed with iron ones.³⁴ To some extent this was made possible by improvements in the techniques of metal casting and turning.

Smeaton is known to have used cast iron gears with wooden teeth in a number of mills³⁵, the first of which, Brook Mill, Deptford, he designed in 1778³⁶. According to Boucher, some engineers had used cast iron segments bolted onto wooden felloes but not until 1784, with Rennie's design for the Albion Mills, London, was cast iron used throughout³⁷.

According to the (Old) Statistical Account, Mr. Kelly, at New Lanark, had lately discovered a new method of erecting the great gear of large machinery in cotton mills, which would require twenty five per cent less water, would save lives and would be applicable to all types of mill. For this he was awarded a premium by the Board of Trustees for

9.2

LEFT: SPUR WHEEL & PINION
BELOW: BEVEL WHEELS



Manufactures³⁸. While the Statistical Account does not provide any further details, a brief entry in the "General View of the Agriculture of Peeblesshire" (1802) gives some indication of the rapidity with which it was disseminated. The "improvement" is identified as being "bevelled work", probably a reference to the transmission of power at an angle by means of cast iron gear-wheels with bevelled faces. The use of "bevelled work" was reported to have originated less than twenty years earlier, at New Lanark, and to have been universally adopted in threshing machines and every new corn mill, that at Spittalhaugh having been the first in the county³⁹. Whether or not bevelled gearing had originated at New Lanark, the example illustrates well the rapidity with which improvements in water mill technology could be diffused in the late 18th century. Lastly, one further improvement in gearing should be mentioned. By taking the drive from the circumference, rather than the centre of a water wheel, it was possible to obtain much higher speeds of rotation from drive shafts and, by means of a belt-drive from the shafts, to eliminate much cumbersome and energy-draining gearing. As with other aspects of mill gearing, this innovation cannot definitely be ascribed to an individual, but Stowers⁴⁰ suggests that it was Fairbairn who first used high-speed shafts in 1818.

Water Wheels

As a material in water wheel construction, wood was far from perfect: intermittent contact with water caused it to rot and the larger the wheel, the more difficult it was to find a design which was at the same time structurally

sound and not excessively cumbersome. If the spokes or "arms" were morticed into the shaft it was considerably weakened. The use of a clasp-arm construction helped solve the problem but still failed to overcome the inherent weakness of wood as a material⁴¹. In an earlier section reference was made to Smeaton's experiments on water wheel design and the conclusions which he reached. In his practical work as an engineer he was able to apply his theoretical knowledge to the full. In 1779, in his design for a furnace blowing engine at Carron Ironworks he introduced the first cast iron water wheel shaft; in 1780 he used wrought iron for buckets⁴². By the early 19th century water wheels of all-iron construction were coming into use. Stowers has spoken of Smeaton's designs as marking the end of an era of wooden water wheel construction⁴³. In reality it would be more accurate to speak of them as the beginning of the end. In the 1820's timber was still being used very widely in the construction of water wheels and other mill machinery, but in a scientific way which recognised the qualities of particular woods and made use of them in the best possible way⁴⁴. Smeaton's theoretical findings on water wheels had a substantial influence on subsequent design practice. To make the greatest possible use of the gravitational power of water, breast-shot wheels were built with a closely fitting breast-work which prevented water from passing the wheel without contributing to its rotation. This comes out well in Smeaton's plan for a boring-mill at Carron (figure 9.3) but can also be seen in a great many later mills throughout Scotland. A further refinement was the depressing sluice,

attributed to Rennie and first used by Smeaton at the Soho Factory in 1784⁴⁵ (figure 9.5). The sluice, which was lowered rather than raised in the conventional manner, enabled water to be drawn off from the top of the lade or shute, thereby increasing the height and the gravitational power of water working on a breast-shot wheel.

To make the best use of the force of moving water it became customary to construct wheels with curved buckets and inlets set at an angle which minimised "shock loss"⁴⁶. With particularly large wheels problems arose with air-locking as the water entered the buckets, and when tail-water was high with the bottom of the wheel running submerged⁴⁷.

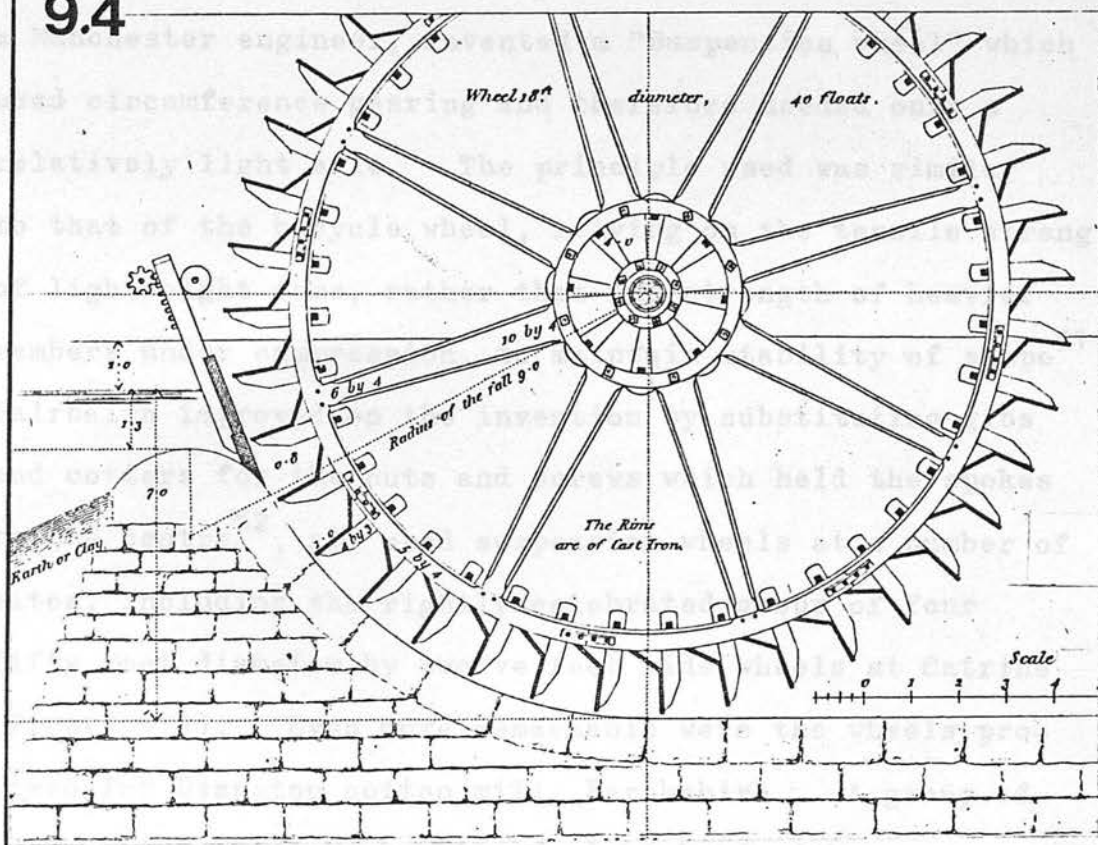
This difficulty was overcome by using ventilated buckets, designed by Fairbairn and first used by him at Wilmslow, Cheshire, in 1828⁴⁸. According to Fairbairn this measure was capable of effecting a twenty-five per cent increase in power⁴⁹.

At least one misconception arose from Smeaton's work. In his experiments he had shown that water wheels were at their most efficient when their circumference moved at a little more than three feet per second, and it became standard practice to design wheels with a speed of about three and a half feet per second. Joseph Glynn is credited with having discovered that greater speeds could be used as the height and diameter of the wheel increased, without any appreciable loss of efficiency. Thereafter he built several iron water wheels of thirty feet or more in diameter, to revolve at six feet per second, thereby reducing the need for gearing and the load on the wheel and axle⁵⁰.

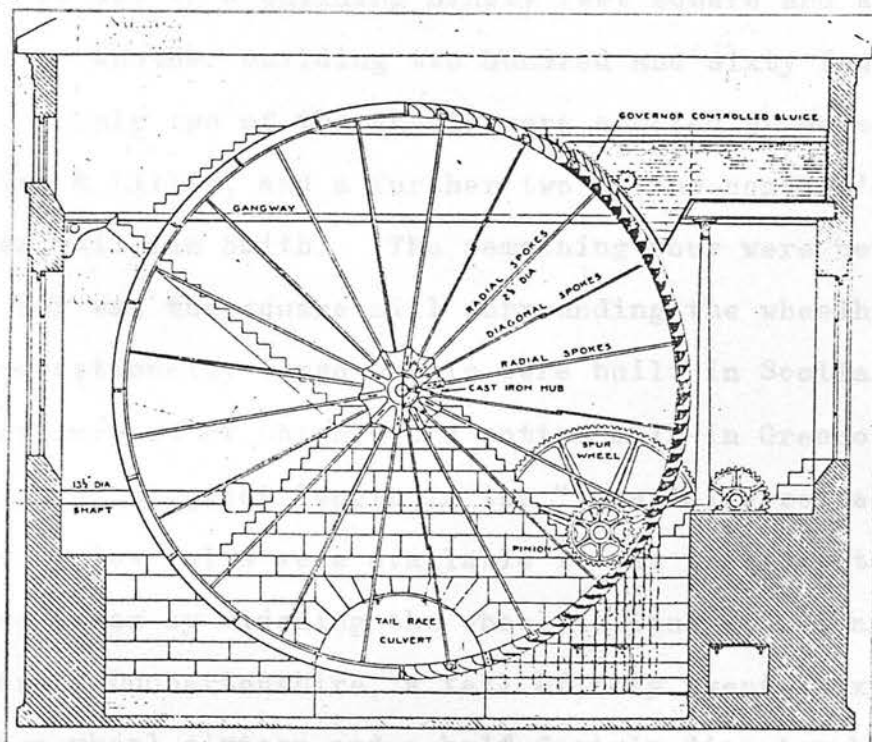
As the demands of industry led to the construction of ever-

9.3

9.4



9.5



larger mills, attention turned to producing lighter, less cumbersome water wheels. In the early 1820's T.C. Hewes, a Manchester engineer, invented a "Suspension wheel" which used circumference gearing and therefore needed only a relatively light axle. The principle used was similar to that of the bicycle wheel, relying on the tensile strength of lightweight arms, rather than the strength of heavier members under compression, to maintain stability of shape⁵¹. Fairbairn improved on the invention by substituting gibs and cotters for the nuts and screws which held the spokes to the centre⁵², and used suspension wheels at a number of sites, including the rightly celebrated group of four fifty feet diameter by twelve feet wide wheels at Catrine (figure 9.5). Even more remarkable were the wheels proposed for Deanston cotton mill, Perthshire. A group of eight water wheels, capable of eight hundred horse power were to be set in a building ninety feet square and surrounded by another building two hundred and sixty feet square. Only two of the wheels were erected by Messrs Fairbairn & Lillie, and a further two by the company's own engineer, William Smith. The remaining four were never built, nor was the square mill surrounding the wheelhouse⁵³. Other exceptionally large wheels were built in Scotland, the very largest of which, at a cotton mill in Greenock, is described at great length in the "Imperial Gazetteer"⁵⁴. Where only low falls were available it was possible to increase power by widening the wheel. Thus at Dalmarnoch printworks, Dunbartonshire, a fall of only twenty-six inches carried a wheel sixteen and a half feet in diameter by fifteen feet broad⁵⁵, and at Linwood cotton mill, Renfrew-

shire, there was an undershot wheel, fourteen feet in diameter by no less than twenty feet broad⁵⁶.

The Industrial Revolution Manchester, 1969 77

See Chapter 3 p. 42

See Chapter 14 p. 215

307 "Patents from the Records of the Burgh of Glasgow"
V (1712-181 Glasgow, 1909 424

1620-1810 Glasgow, 1909 424
Lindsay, J.B. & Cook, M. "Inveraray and the Duke of
Argyll" Edinburgh 1973 423 Appendix: Trademark

Ibid., 423

NLS Acc. 2913/33

SRO MS1/1/11 750 June 1751

SRO MS1/1/12 750 December 1754

James Walker: SRO E.767/35 Report on Mill of Auchna-
gairn, c.1759

James Walker: SRO E.769/125 Report on Mill of
Auchnaigairn, 1762-3

See Chapter 14 p.223

1620-1810 Glasgow, 1909, p.411, 173

Ibid., 423

Ibid., 423

Various various

SRO MS1/1/11 750 June 1751

Letter from Mr. J.W. Cartwright, Bolton, East
Lancashire, drawing my attention to this information.

Walker, C.T.C. "John Rennie 1781-1821, The life and
Work of a Great Engineer" Manchester, 1963 2, 3

See Chapter 14 page 214

See Chapter 12 p. 158

SRO MS1/1/11 750 June 1751

- 1 : Musson, A.E. & Robinson, E. "Science & Technology in the Industrial Revolution" Manchester, 1969 71
- 2 : See Chapter 2 p. 42
- 3 : See Chapter 14 p. 216
- 4 : SBRs "Extracts from the Records of the Burgh of Glasgow" V (1718-38) Glasgow, 1909 424
- 5 : Lindsay, I.G. & Cosh, M. "Inveraray and the Dukes of Argyll" Edinburgh 1973 423 Appendix: Tradesmen
- 6 : Ibid., 423
- 7 : NLS Acc.2933/350
- 8 : SRO NG1/1/11 7th June 1751
- 9 : SRO NG1/1/12 13th December 1754
- 10 : Andrew Meikle: SRO E 769/35 Report on Mill at Auchnagarden, c.1759
- Robert Meikle: SRO E 769/125 Report on Mill of Auchnagairn, 1762-3
- 11 : See Chapter 14 p223
- 12 : Lindsay & Cosh, op.cit., 173
- 13 : Ibid., 423
- 14 : Ibid., 423
- 15 : Sources: various
- 16 : SRO NG1/1/12 15.12.52
- 17 : I am indebted to Mr. J.N. Cartwright, Bolton, East Lothian, for drawing my attention to this information.
- 18 : Boucher, C.T.G. "John Rennie 1761-1821. The Life and Work of a Great Engineer" Manchester. 1963 2, 3
- 19 : See Chapter 14 page 214
- 20 : See Chapter 12 p. 188
- 21 : SRO GD215/1825/35 (1785)

- 22 : Scots Magazine LI (1789) 211
- 23 : Handley, J.E. "The Agricultural Revolution in Scotland"
Glasgow 1963 104
- 24 : OSP 485:25 Haddington Burgh Council v. Haddington
Tarred Wool Co.
- 25 : See Chapter 14 page 227
- 26 : Boucher, op.cit., 3
- 27 : Ibid., 5
- 28 : NLS Acc 5111/25
- 29 : Boucher, op.cit., 6
SRO NG1/1/28 £30 to Professor Robison at University
of Edinburgh, for experiments on the motion and action
of water. Wants to do experiments in Renfrewshire
cotton mills. Thinks that he has developed a rule.
- 30 : Boucher, op.cit., 8
Musson & Robinson, op.cit., 76
- 31 : Burne, E.L. "On Mills. Thomas Telford, 1796" TNS
XVII (1936-7)
Wilson, P.N. "The Water Wheels of John Smeaton" TNS
XXX (1955-7)
Smeaton, J. "Reports of the Late John Smeaton" 3 vols
London 1812
Fairbairn, Sir W. "Treatise on Mills and Millwork"
2 vols., 4th Edition, London 1878
- 32 : Bowman, G. "John Smeaton - Consulting Engineer" in
Semler, E.G. (Ed) "Engineering Heritage" Vol 2, London
1966 11, says that the best overshot designs were
almost twice as efficient as the best undershot.
Wilson, P.N. "Water-Driven Prime Movers" in "Engineering
Heritage" Vol 1 London 1963 30. Gives the efficiencies
of overshot and undershot wheels as 63% & 22% respectively.

- 33 : Wilson, op.cit., (1963) 30
- 34 : The same combination of wood/iron is used to this day.
- 35 : Wilson, op.cit., (1963) 30
- 36 : Wilson, op.cit., (1955-7) 33
- 37 : Boucher, op.cit., 83
- 38 : OSA IV 35 Lanark, Lanarkshire
- 39 : Findlater, C. "General View of the Agriculture of Peeblesshire" Edinburgh, 1802 27
- 40 : Stowers, A. "Observations on the History of Water Power" TNS XXX (1957-9) 252
- 41 : Wilson, op.cit., (1963) 30
- 42 : Wilson, P.N. "Water Power and the Industrial Revolution" Water Power, August, 1954, 312
- 43 : Stowers, A. "Water Mills" in Singer, C., Holmyard, E.J., E.J., Hall, A.R., & Williams, T.I. (Eds) "A History of Technology" 5 vols., Oxford 1956-9 IV 209
- 44 : See Monteath, R. "The Forester's Guide & Profitable Planter" Edinburgh 1824 193-4
- 45 : Boucher, op.cit., 79
- 46 : Wilson, op.cit., (1963) 30
- 47 : Ibid., 30-1
- 48 : Stowers, op.cit., (1957-9) 252
- 49 : Wilson, op.cit., (1963) 31
- 50 : Stowers, op.cit., (1956-9) 205
- 51 : Musson & Robinson, op.cit., 70
- 52 : Fairbairn, op.cit., I 120-1
- 53 : Ibid., I 128-9
- 54 : Wilson, J.M. (Ed) "The Imperial Gazetteer of Scotland" 2 vols. Edinburgh, London & Dublin, N.D. (c1875) I 17
- 55 : NSA VIII 224 Bonhill, Dunbartonshire
- 56 : NSA VII 51 Houston & Killallan, Renfrewshire

THE RURAL CORN MILL

"There stand three mills on Manor Water,
A fourth on Posso Claugh,
Gin heather bells were corn and bere,
They wad hae grist eneugh"¹.

In 1730 the pattern of Scottish grain milling was still the traditional one of many small mills, each grinding oats and bere for astricted clients, in simple buildings constructed for the most part from local materials. By 1830 a far smaller number remained and of these, most were well equipped mills, working for cash and utilising the products of science and industry in their design and construction. Why did such a change come about and what form did it take?

Technical Developments

Improved machinery was an important pre-requisite for the more centralised manufacture of grain and it was largely because of development in technology that, by the end of the period, requirements could be met by a far smaller number of mills than had been necessary at the beginning; at least one contemporary writer cites it as the most important single factor in the decline of corn mill numbers². Other sources point to the inefficiency of existing mills: reporting on the mill of Auchnagarden (Inverness) Andrew Meikle claimed that, given the proper machinery, it could perform the same work with half the water³ while a survey made in 1816 claimed that one good mill could have carried out all the work of the six "wreched" mills in Strathfleet, Sutherland⁴. Between 1730 and 1830 building standards showed a marked improvement. The single storey clay, rubble or turf mill,

with its roof of thatch or divots, was cramped and required frequent stoppages for rebuilding to take place. At the turf-roofed Mill of Cranston (Midlothian) the "stooling" was very low and the pit below consequently dark and dirty. The dirt which gathered in the pit increased wear and tear on the pit wheel and when it came to replacing a cog, access was very difficult and repairs very time-consuming. Furthermore, it was impossible to detect whether grain was spilling from the millstones down to the pit below⁵. By 1830, such mills had vanished from all but the most isolated corners of the country, and in their place had been built two- or three-storey mills, with cemented walls of rubble or ashlar, and roofs of pantile or slate. Within the mill sufficient room was available to separate the machinery onto different floors; to accomplish all the lifting which the extra height made necessary, water-powered sack hoists and grain elevators were often installed⁶. Mills equipped with two or more pairs of stones could carry out the processes of shilling and mealing on separate stones, eliminating the need for tentering between the two processes, doubling the capacity of the mill. Ample space was left for storage and, as often as not, a kiln was appended to the mill building, with direct access provided between the two. Figure 10.1 shows a typical "Improved" corn mill of the early 19th century. In 1730, farms in many districts still had their own circular kilns, "miserable hovels, covered with straw" and containing a framework of boughs (kiln-ribs) which supported a platform of heather or straw (kiln-head) upon which the grain was laid out; kilns of this type were to be found at some, but by no means all, corn mills.

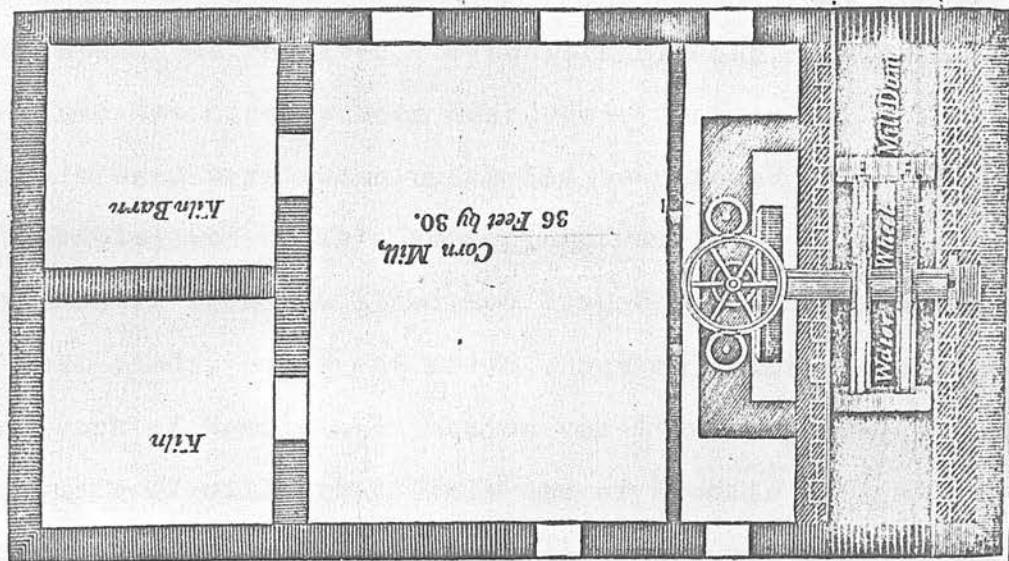
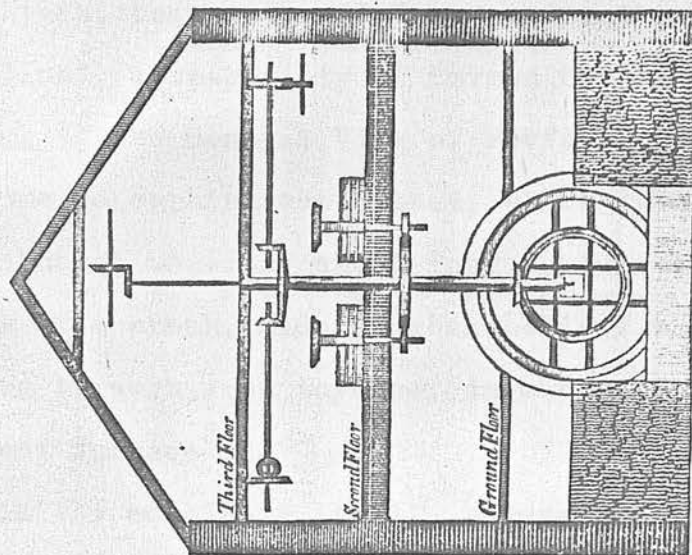


Fig. IV.



In the widespread re-building of the 18th and early 19th centuries, kilns of this type were replaced by rectangular ones, roofed with pantile or slate. Perforated tiles took over from heather and straw in the kiln-head, and by the 1790's, in central Scotland at least, earthenware tiles had, in turn, been superseded by perforated metal plates, or "yetling", a speciality of Carron Company's forges⁷. According to the General View of Forfarshire, kiln design had become so sophisticated that, where water was available, a small bucket wheel of about four feet in diameter was, by means of a crank, made to work bellows which blew the kiln fire through iron tuyeres, in much the same way as in a blast furnace⁸.

It was in the machinery itself, however, that improvements were most marked. A scientific approach was taken to mill design: precise calculations were made as to available water-power and gear ratios were manipulated to give high or low speeds as required. The work of John Smeaton in this field has already been discussed (Chapter 9). The materials used were those which had been found to be the most durable, and notable among them was iron. Small quantities of iron and steel had long been used for spindles, gudgeons, rinds, bands and nails⁹, but only after the pioneering work of Rennie and Smeaton was it widely used for major parts of millwork. This use of iron is well illustrated by Coll Mill (Berwickshire), which was rebuilt in 1826 to incorporate a cast iron axle seven inches square, a pit wheel of cast iron and a cast iron spur wheel with wooden cogs¹⁰. Iron was also coming into use for water wheels, but although its use was encouraged by early 19th

century shortages, the latter material continued to be that more generally used until at least 1830.

Where iron was not used, it was the timber best suited to any one purpose that was used in that particular context. For the shrouding, paddles and buckets of water wheels, black or white saugh was deemed most suitable; for sluices and dams, the durability of larch under water recommended its use. For axletrees oak was still favoured, though this was often the first piece of wooden machinery to be replaced by iron. Sycamore, willow and beech were all popular woods for machinery, beech being widely used to cog iron gear wheels¹¹. In the early 19th century Memell pine from the Baltic came into general use¹². Using the most suitable and durable materials a mill could run more efficiently, at a greater capacity, for longer periods without the necessity of a major overhaul. By drawing on skills accumulated over the previous two centuries, Scottish millwrights were able to build such mills and often added innovations of their own. In this field the work of Robert, Andrew and George Meikle was particularly notable and it was from Andrew that the engineer, John Rennie, gained his knowledge of millwrighting.

The Impact of Agricultural Improvement

Improved technology may have provided the means whereby the number of mills might be reduced, but to get closer to the cause of change one must look at the impact of developments in agricultural techniques.

The complexities of the Scottish Agricultural Revolution have been adequately dealt with elsewhere:¹³ on the basis of these works it appears that the most significant changes

were as follows: the drainage and enclosure of land; the creation of new steadings, roads and plantations; the amalgamation of agricultural holdings; new implements, new crop rotations and new strains of livestock. The net result of all these changes was the raising of agriculture above subsistence level and its integration into the economy. For grain milling, the most significant changes were the new crop rotations and the draining of lochs and marshes. Under the "old system" the "infield", which was subjected to constant tillage, carried a manured crop of bere followed by two unmanured crops of oats. The "outfield", patches of which were ploughed up from year to year, was planted with oats and crops taken until such time as returns ceased to justify further planting, at which juncture a fresh patch was cleared and cultivated. Although there were variations in infield rotations, such as the inclusion of beans, peas or wheat, by far the greatest acreage was occupied by oats¹⁴. It was this heavy dependence on oats, and to a lesser extent bere, which enabled mill owners to enforce and to benefit from thirlage. As a result, corn mills came to be built wherever sufficient land was cultivated and, in some cases, even where it was insufficient. The new rotations on the other hand included such crops as turnips, which had previously been confined to the kail yard, clover and ryegrass, both previously unknown in Scotland; there was also an increase in the acreage under barley and wheat. To make way for the cultivation of these crops, the acreage under oats had to fall. Early "improved" rotations still showed an excessive dependence upon grain crops: a typical rotation at this time

might be, fallow or turnips; wheat or oats; peas; barley; clover; oats or wheat. By the 1790's however, the following were becoming more common: on rich clays fallow, wheat, beans, barley, clover, oats; on deep free loam turnips, barley, clover, oats, beans, wheat, and on light and weak soils turnips, oats or barley, clover, oats or turnips¹⁵. On those estates where the new rotations were introduced, the reduction in oat and bere acreages was enough to affect the viability of those mills with only small thirls, or low multure yields. At the Mill of Carsehead (Perthshire), the multures payable in 1777 amounted to only twenty-one bolls, out of which had to be paid a rent of twenty bolls¹⁶. According to the O.S.A. entry for New Monkland, Lanarkshire, poor multure yields were responsible for the decay of some of the parish's seven mills¹⁷. In 1754, the tacksman of Gifford Mill (East Lothian) complained that several tenants were enclosing and laying ground down to grass, thereby jeopardising his livelihood; to keep the mill working, the Barony Court had to rule that farmers were to pay the multure of ten bolls of oats and five lippies hummel corn for each ploughgate converted from grain¹⁸. When Robert Henry entered into a tack of the Mill of Ussie (Kincardineshire) he did so believing that the mill dues would cover the rent but by 1821, on account of the mill serving an area of large farms mostly under wheat, turnips and grass, mill-dues came to less than half the sum expended on rent and maintenance¹⁹. Were it not for the extension of cultivation, and the higher yields made possible by new strains of oats, it is probable that many more mills would have disappeared as a result of new rotations.

Even in fertile, well-cultivated areas, the landscape of early eighteenth-century Scotland was pockmarked with lochs, pools and marshes. To the Improving landowner they represented a barrier to Improvement and a blight on his estate which had to be removed. The more extensive of these bodies of water had often been utilised as reservoirs for mills; in the prevailing mental climate of the Age of Improvement, the potential agricultural value of flooded land was considered much greater than any advantages which might accrue from a mill. Leslie, in his General View of Moray and Nairn, complains of two mills, one derelict, one little used, which prevented the Loch of Inchstellie from being drained²⁰, while of Fife, Thomson reported that although one such obstruction had been removed, a further three to four hundred acres (Scots?) of good land in Kiltarlity parish was still submerged under the dams of three corn mills²¹. In the same county, four mill-dams on the Water of Motray continued to obstruct the drainage of meadow-land, despite offers of compensation to the mill owner²². The requirements of an overshoot wheel at Luffness Mill, East Lothian, long prevented the draining of a six-mile tract of high quality agricultural land alongside the Peffer Burn²³. More often than not, lochs and ponds were finally drained, but usually to the detriment of those mills which had depended on them: in 1756, following drainage work on the Lake of Menteith, it was claimed that the Mill of Cardross (Perthshire) below it, would have insufficient water in winter to serve its thirl²⁴, while the mills on the River Ore (Fife), which had previously enjoyed a steady water supply, suffered frequent stoppages after the partial drainage of Loch Ore²⁵. Even more harmful

was the introduction of sub-soil drainage to large areas of upland, although the process had made little progress by 1830. While it is impossible to gauge how many corn mills were lost through drainage operations, the total probably stands at well over one hundred. In Aberdeenshire, the straightening of just one burn and its tributaries, and the draining of the lands beside it, led to the abandonment of no less than seven mills²⁶.

For the Improving landowner the extension and beautification of his house and parks was as necessary a measure as enclosing fields or rebuilding steadings; indeed the proceeds from the new agriculture were often put to just such a use. One side effect of the extension of parkland was the removal of mills, and of the few which were rebuilt, all were a safe distance from the landowner's house. The Mills of Relugas (Moray), just above the junction of the Divie and the Findhorn, were removed to make way for pleasure grounds²⁷, as were the Mill of Winton and the Mill of Whittingehame, both in East Lothian²⁸; neither they nor the Mill of Relugas were rebuilt. A similar fate befell Kimmerghame East Mill, in Berwickshire²⁹. In 1731 emparking at Taymouth Castle, Perthshire, swallowed up a third of the thirl of the Mill of Taymouth³⁰; some sixty years later, at the opposite end of Perthshire, two mills on a burn between Lonforgan and Abernethy parishes were pulled down, once again to make way for pleasure grounds³¹.

The Decline of Thirlage

Whatever the losses sustained as a result of new agricultural practices, by far the greatest contribution to the decline

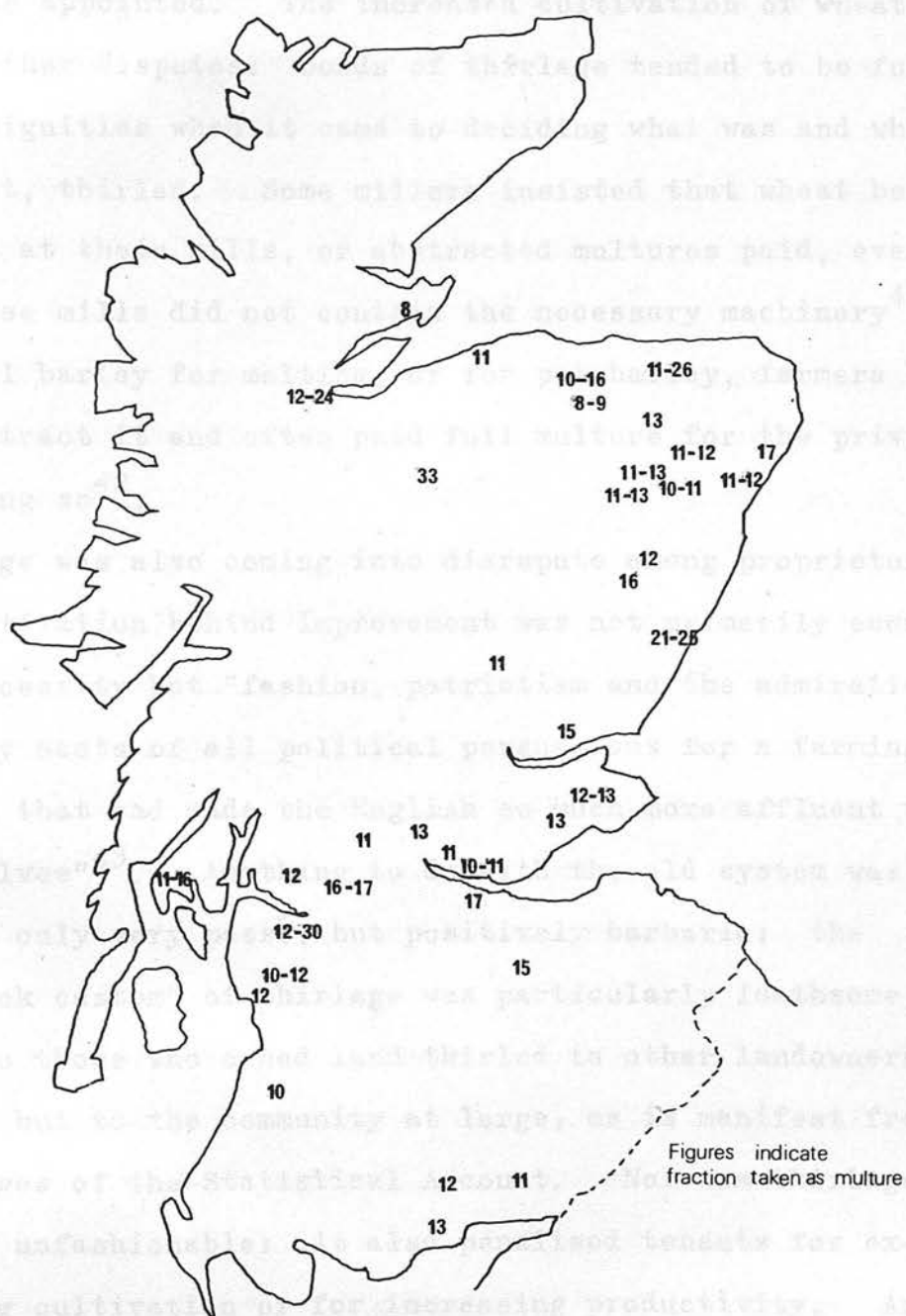
of the rural corn mill came from the decay and abolition of thirlage. In Chapter Two it was argued that, while levels of production remained more or less stable, communications poor and the free market for grain small or inaccessible thirlage did no more than to ensure that the miller received enough in multures to pay his rent and the proprietor enough rent to justify maintaining the mill. Under the new agriculture however, the suckeners' traditional resentment of thirlage was heightened by an awareness of the changed circumstances under which mills operated. In some areas the cultivation of wastes, combined with the use of improved strains of oats, produced a situation in which multures and knaveship yielded vastly greater quantities than were, in fact, required. There were some enlightened landlords, such as Robertson of Lude, who stipulated that newly cultivated lands were to pay only one thirtysecondth in multures³² but on the other hand some tenants, such as those in Tulliallan parish (Fife), were obliged by clauses in their leases to grow oats rather than other unthirled crops and to pay one tenth to one eleventh in multures³³.

The increasingly common practice of rousing mill tacks, instead of re-installing the families which had traditionally tenanted the mill itself or another in the locality, tended to push multures higher; prospective tenants of roused mills were often led to offer sums well above their means and more than once, when the highest bidder failed to find cautioners, mills had to be let to the second highest, or re-roused³⁴. Furthermore, those with the money to offer the highest rent were not necessarily the most skilled in

milling. At the roup of the Bridge Mill of Park (Wigtownshire) in 1769, the highest bidder was a mason who "would find it difficult to carry on to any advantage, a business to which he was not bred and of which he was entirely ignorant". Despite that fact his high bid was accepted with disastrous consequences for himself, the thirl and the mill owner³⁵. Even if a tack did go to an experienced miller, he was often forced to exact much higher multures than were due, if only to pay his inflated rent; this was certainly the case in Halkirk parish, Caithness, where the link between augmented rents and heightened multures was clearly recognised³⁶. At Milton of New Tarbat, Ross-shire the customary multure of one sixteenth malt and meal had risen by 1780 to one tenth oats and more than one ninth bere, probably for the same reason³⁷. From the Old Statistical Account it is quite apparent that, by the end of the 18th century, multure rates had risen to excessively high levels (figure 10.2).

For the suckeners, the tacksman and the mill owner, the issue of multures could, and often did, "lay the foundations for many tedious and expensive littigations (sic)"³⁸, especially if a dispute reached the Court of Session. In that unfortunate event a process could drag on for decades, at great cost, and without any assurance of the issue being resolved. One such process, introduced in 1780, was still going strong in 1796³⁹. The rulings of Barony Courts had never been very effective in controlling abstractions and, as the Barony became less self-contained, the enhanced prestige of the tenantry was accompanied by a corresponding decline in the powers of the Barony Court. On a higher

10.2



level, a dispute could be taken to a Sheriff Court but to do so cost money and could result in a case being referred to the Court of Session. In at least one case involving miller and tenants, both parties withdrew and agreed to pay their own costs, rather than proceed with a potentially expensive litigation⁴⁰. Occasionally an independent arbiter was appointed. The increased cultivation of wheat led to further disputes: bonds of thirlage tended to be full of ambiguities when it came to deciding what was and what was not, thirled. Some millers insisted that wheat be ground at their mills, or abstracted multures paid, even if these mills did not contain the necessary machinery⁴¹. To sell barley for malting, or for pot-barley, farmers had to abstract it and often paid full multure for the privilege of doing so⁴². Thirlage was also coming into disrepute among proprietors. The motivation behind Improvement was not primarily economic necessity but "fashion; patriotism and the admiration felt by Scots of all political persuasions for a farming system that had made the English so much more affluent than themselves"⁴³. Anything to do with the old system was seen as not only very passé, but positively barbaric; the "Gothick custom" of thirlage was particularly loathsome, not only to those who owned land thirled to other landowners' mills, but to the community at large, as is manifest from the pages of the Statistical Account. Nor was thirlage simply unfashionable: it also penalised tenants for extending cultivation or for increasing productivity. Any enlightened landowner must have been fully aware of the threat which thirlage posed to the success, economic and

aesthetic, of his Improvements. On the other hand, landowners were still loth to relinquish the useful source of income obtainable from multures, or from the high rents obtainable from mills let with them: the abolition of thirlage could lower a mill's value by twenty per cent. In 1763, faced with the potential abolition of his thirlage, the tacksman of the Mills of New Tarbat (Ross) asked that his rent be reduced by thirty bolls from £107 3s 4d⁴⁴. In the event most landowners managed to find a solution which, while apparently abolishing thirlage, still left them with some of its financial benefits. The least radical measures that a landowner could take was to lower multures from intown to outtown rates. Part of the Banff estate, Angus, was thirled at intown rates to the Mill of Fyall; at the letting of the mill in 1791 however, the multures of the Mains of Banff were reduced to outsucken rates and provision was made for the rest of the thirl to be likewise converted. As compensation, the miller was to have a reduction in rent of 10s Sterling per ploughgate, or £7 10s for the whole barony⁴⁵; by 1806, the entire thirl had been put onto outsucken rates⁴⁶. As early as 1770, the suckeners of Innerwick and Thornton Mills were paying only outtown rates, though in this particular case this may have been traditional practice⁴⁷. While such a measure lightened the burden of thirlage and thereby encouraged cultivation, it detracted from the value of a mill without abolishing the distasteful thirlage. A more effective step was the conversion of multures to a cash equivalent which could be paid by each of the suckeners

as part of their rent. This system offered the twofold advantage of appearing to free the tenants from thirlage while ensuring that the proprietor still received the income which had formerly accrued from it. Furthermore, the fixed commutation meant that suckeners were no longer penalised for increasing their crop yields. Containing as it did something for both proprietor and suckeners, fixed commutation found support in both groups. By the 1790's it had been applied widely, notably in Aberdeenshire and the north east. In Grange parish, Banff, very high multures of one eighth or one ninth were converted at 2s 3d in the pound rental⁴⁸, while in Turriff parish, Aberdeenshire, a rather higher rate of 4s 6d in the pound had been fixed⁴⁹; elsewhere in Aberdeenshire, in the parishes of Alford, Kemnay and Deer, the same system was in operation, but at unspecified rates⁵⁰. Fixed commutations were also established in Dunning and Trinity-Gask parishes, Perthshire, and in Buchanan parish, Stirlingshire⁵¹.

Heritors with lands thirled to another's mill could buy their lands out of thirlage and pass on part of the expense to their tenants. In 1779 Stewart of Ascog agreed to free Lamont of Knockdow's Argyllshire lands of Towardnuilt darich from thirlage, multures and services for £1 6s 8d Sterling per annum⁵². Those heritors bound to the Mill of Cart (Renfrewshire) bought up their thirlages from the mill owner, and charged the interest to their respective tenants at 6d per acre⁵³. On the Leckie estate, Gargunnock (Stirlingshire), the proprietor took the mill into his own hands and, for a levy of 1s per acre, freed his tenants from thirlage⁵⁴. Examples of this type of commutation were also to be found

in Argyllshire, Ayrshire and Kirkcudbrightshire⁵⁵ (figure 10.3).

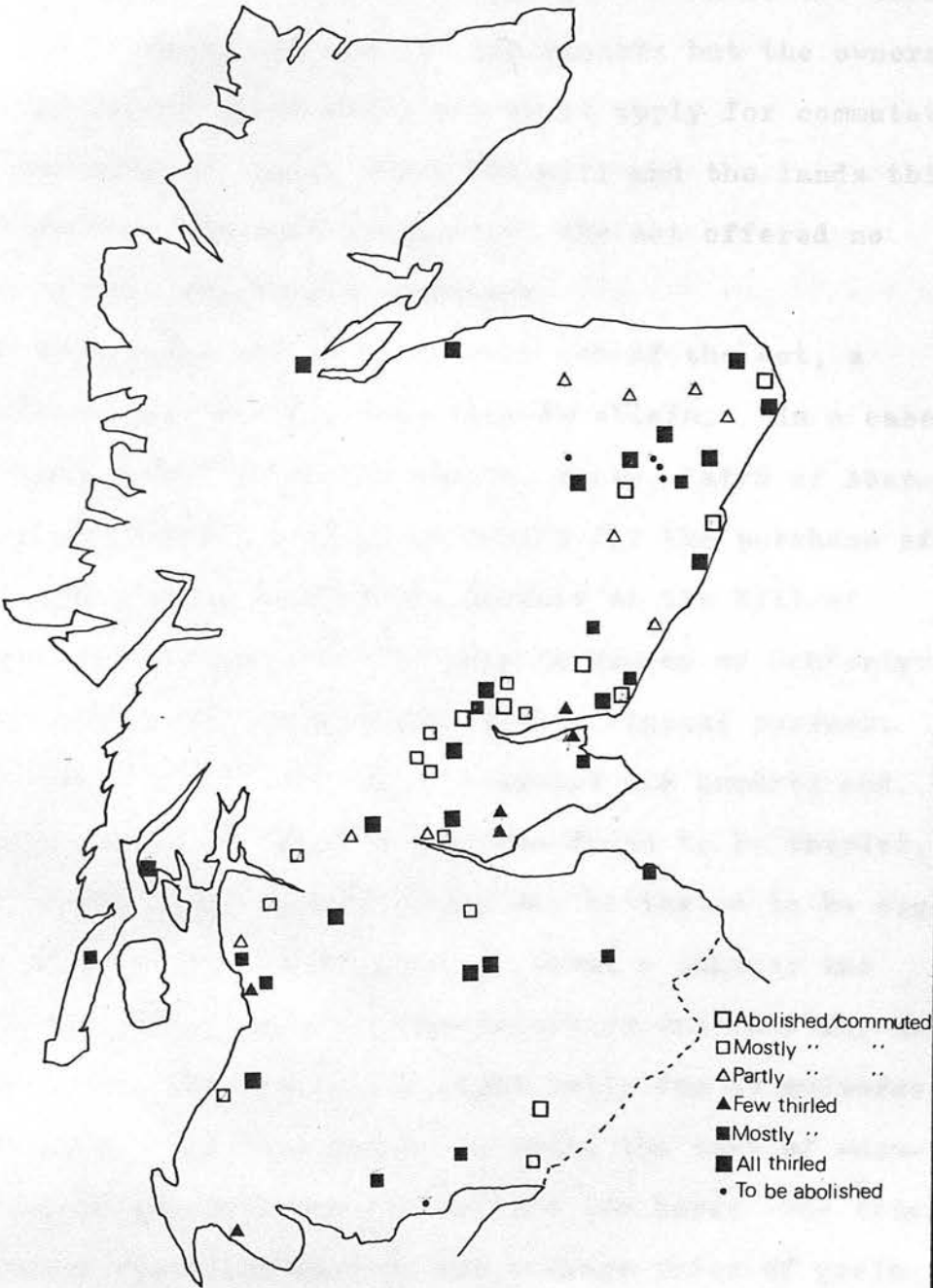
A further method of ameliorating the bad effects of thirlage involved letting a mill and the rights to its multures to those thirled to it. On 30th March 1781, James Robertson of Lude made a personal appearance at his Baron Court and proposed that the Mill of Kindrochit be let to the tenants of the estate at a yearly rent of £70 5s Sterling; the tenants unanimously approved the experiment for a one-year period⁵⁶. According to the O.S.A. the heritors of Foulis Wester parish (Perthshire) had given up the high multures formerly payable at the parish's five mills and had divided the mill rents among the suckeners⁵⁷. By the 1790's suckeners also held mills in Kirkpatrick-Fleming parish (Dumfriesshire) and Arbirlot parish (Angus)⁵⁸.

While examples of commutation, in one form or another, were to be found in most parts of Scotland, such enlightened policies were still, in the 1790's, the exception rather than the rule. Even a progressive body such as the Forfeited Estates Commission was known to refuse to free tenants from thirlage, on the flimsy pretext that since "the mill was... the most convenient and adjacent the tenants could reap no advantage by being freed"⁵⁹.

Abolition by Statute

Opposition to thirlage continued to mount; of the 848 entries in the Old Statistical Account, a great many condemned the practice, sometimes at great length, but only three condoned it. None spoke in its favour⁶⁰.

In 1799, largely as a result of efforts by the newly-formed



Highland and Agricultural Society, an Act was passed which made legal provision for the abolition of thirlage⁶¹. The preamble which spoke of thirlage as "checking the industry of the occupiers of the ground, and ... occasioning troublesome and expensive litigation", suggested that suckeners be allowed to obtain a commutation for a fixed annual payment, or by buying up their thirlages outright. Under the terms of the Act, however, it was not the tenants but the owners of thirled lands, or of mills who could apply for commutation; in the majority of cases, where the mill and the lands thirled belonged to the same proprietor, the Act offered no redress to the unfortunate suckeners. For the proprietor who chose to make use of the Act, a commutation could be very expensive to obtain. In a case quoted by Handley⁶², Colonel Charles Moray, Laird of Abercairny (Perthshire), brought an action for the purchase of multures payable by some of his tenants at the Mill of Carsehead, the property of Sir Patrick Murray of Ochtertyre. Not until 1815, after the death of the original pursuer, was the case finally concluded. Almost one hundred and forty-eight acres of Moray's land was found to be thirled, from which the total annual return was estimated to be eight hundred and three bolls of grain. About a quarter was deducted for seed, and a further deduction was made for horse corn and teind, leaving thirty eight bolls due as multures and knaveship. To this had to be added the cost of manufacture at 8d per boll and dry multure for bere; the total annual value was calculated on the average price of grain for the ten years preceding the commencement of the suit. The Lord Advocate's decision, that £1,025 2s 1d Sterling

should be paid, was contested by Moray who pointed out that the crop yields upon which the calculations were based were obtained through the use of improved methods introduced after the commencement of the suit in 1803. A sum of £860 was suggested as a fair price and the final settlement was made for the sum of £900⁶³. Any landowner prepared to pay out so large a sum to free so small an area would have to be not only a very strong opponent of thirlage, but also a man of financial means.

The cumbersome working of the Act could serve only to deter potential users even further. Part of the blame lay with the "vague and inexplicable nature of its subject"⁶⁴ and a complex legal mechanism was required if a fair assessment of a thirlage's value was to be achieved. Once a petition had been brought before the Sheriff, he was to order it to be served on the other party and on the tenant of the mill in question; at the same time all other parties were to be cited, by means of an edict at the church(es) of the parish(es) in which the lands and mill were situated. If residing in Scotland, the party on whom the petition was served had to lodge answers and submit any objections to the petition, stating all claims, within forty days; those parties resident outside Scotland were allowed sixty days. Within thirty days of the expiry of this period, the Sheriff was to decide what information was relevant to the case; after a further twenty days, he was to appoint a jury for a certain day, giving them another twenty to thirty days' notice. Initially, the jury was to consist of twenty men, each either heritors with at least £30 Sterling valued rent, or tenants paying £30 Sterling in rent. The two parties were then to

reduce the number of jurors one by one, alternately, the mill proprietor naming the first, until only nine men were left. In the absence of both parties, the Sheriff was to assume responsibility for so doing. Evidence had to be taken in writing and preserved for at least four years; once a decision was reached, it had to be entered in the Register of Sasines within sixty days⁶⁵. Because of its very limited terms of reference, the 1799 Act could not hope to help anyone other than those few heritors whose lands were thirled to another's mill; tenants, whose interests in land were only transient, could not raise actions to free their rented lands from thirlage. As it happened, the need for further legislation was overtaken by circumstances. On the better estates, thirlage had already been ameliorated or abolished and the Act specifically excluded situations where dry multure had already been fixed. Moreover, for all its shortcomings, the Act did help to mobilise public opinion by giving the state's backing to the already substantial anti-thirlage lobby. By 1814, Sinclair of Ulbster could state that "few country gentlemen above the rate of a Squire Western in point of intellect, ever now think of confining their own tenants to their own mills under such preposterous bondage"⁶⁶.

Grinding for the Open Market

As the period progressed and circumstances changed, larger, more efficient mills began to appear; once mills were freed from catering solely for the needs of astricted clients, their size and the milling capacity available in any one area could be adjusted to whatever level was required. Those grain-producing areas which had good access to ports, or to

urban markets, showed a marked concentration in milling capacity: mills within ten miles of Eyemouth or Berwick exported great quantities of manufactured grain via these ports⁶⁷, while at the opposite end of the Merse, three grain mills in Gordon parish produced ten to twelve thousand bolls of meal per annum, most of which was driven in carts up the turnpike road to Edinburgh, Dalkeith, Musselburgh and Prestonpans⁶⁸. The meal mill at Cramond Bridge, near Edinburgh, manufactured one thousand bolls of oats per annum⁶⁹; Clyde's Mill, near Glasgow, which was capable of grinding thirty to forty bolls per day, was almost constantly employed: in winter and spring local farmers used the mills, and in summer and autumn, Glasgow grain dealers kept them occupied grinding foreign oats, one to two thousand bolls of which were milled each year⁷⁰. The more large commercial mills there were, the less the need for the smaller, more primitive ones. A further incentive was given by the greatly enhanced value which wartime shortages gave to grain during the years 1793 - 1803. In Midlothian, barley rose in price from 20s per boll in 1793 to 30s in 1810, while oats, from being 16s per boll in 1793, rose to 42s on one occasion and averaged 28s for the war years⁷¹. As a result, it became much more remunerative for the miller to become a manufacturer of, and dealer in, grain, the profits accruing therefrom often being sufficient to persuade the miller to relinquish the astringency of certain lands, particularly if that entailed responsibilities such as transporting grain and meal. In Berwickshire, where millers were said to despise the petty profits of thirlage, the custom was falling into disuse by 1808⁷² and in Angus it had been totally eliminated by 1813⁷³. Inflation in rents

and abnormally high profits during the wartime years led to a spate of mill building and re-building which, temporarily at least, compensated for the abolition of thirlage. Thus in 1813, Headrick could report of Angus mill rents that "when leases expire, the increase (in value) is progressive"⁷⁴.

By the early 19th century, communications in rural areas were good enough for farmers to have a choice of mill from several within easy reach. Nor surprisingly, they chose those mills which had the most reliable water supply, the greatest accessibility, the best machinery and the cheapest rates of grinding. To some extent these qualities reinforced each other: a good water supply offered a longer period during which work could be undertaken and therefore higher profits to re-invest in machinery. Alternatively, such a mill might cut profits to the level obtained by a mill with a poor water supply, but in doing so, it would be able to undercut the latter on prices. If reasonably accessible, a well-equipped mill with a good water supply and competitive rates, stood a good chance of surviving. On the other hand, a mill with an unfavourable combination of these factors was unlikely to do so, especially with the falling grain prices and retreating cultivation margins of the post-war era. Proprietors who had more than one mill often allowed their smaller, less efficient mills to decay whilst rebuilding and re-equipping the best mills, on their estates.

Besides giving the farmer a choice of mill, the abolition of thirlage also opened up the possibility of his avoiding milling altogether. Although in many cases thirlage had been limited to the grower's own grain needs, in many more

it applied to the whole saleable corn; without the disincentive of abstracted multures, selling unground grain became a much more attractive proposition. Here again improved transport facilities in the form of turnpike roads and canals, brought markets within easy reach of producers; the growing importance of secondary and tertiary occupations will be considered in more detail at a later stage. While this brought a boost to urban and port-orientated mills, it served only to accelerate the decline of the rural mill. Just as it had been thirlage that had made so great a number of corn mills viable, it was its abolition that, more than anything else, led to a decline in their numbers.

Changes in Diet

Even more marked than the changes in agriculture were those taking place in industry. Aided by the Board of Trustees for Manufactures, the Scottish linen industry went from strength to strength during the 18th century, offering many opportunities for employment in its several branches. On a more general level, the push exerted by agricultural Improvement and the pull of large-scale industrial undertakings, such as the Carron Ironworks or the cotton mills of the late 18th century, led to a decrease in those living off the land and an increase in those depending on a wage to buy their food. Existing towns, such as Glasgow and Dundee, experienced rapid growth and new communities, such as Johnstone and Stenhousemuir, appeared where there had been only open ground. The higher standard of living enjoyed by the industrial wage-earner opened up the possibility of an improved diet, one feature of which was the substitution of wheaten bread for oatcakes and barley bread; by 1830 wheaten bread had also

made a lot of headway in rural areas. This change of tastes encouraged the cultivation of wheat, often at the expense of lower priced oats, and further aggravated the already unfavourable position of the rural corn mill.

Conclusion

Between 1730 and 1830 a number of factors combined to contribute to the decline of the rural corn mill. Changes in land use, notably the diversification of crops grown, the drainage of lochans and the extension of parkland, reduced the acreage under oats or bere. Thirlage gradually fell into disuse and in the free-market conditions which ensued, farmers were able to grind meal at the best mill available or to dispose of grain unmilled; with better communications, markets could be found further afield. Industrialisation and a move away from the land brought changes in population distribution and improved standards of living which in turn produced a shift in diet away from meal to flour. Developments in technology not only helped make this industrialisation possible, but also enabled larger, more efficient corn mills to be built; with an increasingly wide range of other uses for water power, corn mills offering low profitability could be more usefully applied to other purposes (figure 10.4). Without doubt, the number of corn mills fell, although the exact number cannot be ascertained.

The last word, however, should be to David Low who, writing in 1818, recognised the decline and identified the cause:

"Common corn mills are now a less favourite and valuable possession than formerly, the number of mills

10.4

Conversion of Corn Mills to other Uses

<u>Mill</u>	<u>New Use</u>	<u>Date</u>
Nether Mill of Dalnotter (Dunb.)	Ironworks	1769
Fauldhouse Mill (W. Loth.)	Gunpowder Mill	1812
New Mills (Renf.)	Cotton Mill (Site)	c1780
Penicuik Mill (Bank Mill)	Paper Mill	1803
Mill of Cambus (Clack.)	Distillery	1806
Mill of Brighton (Angus)	Flax-spinning Mill	1788
Mill of Struthill (Perths)	Oil Mill	1780
Old Mill of Strichen (Ab'n)	Wool-carding Mill	c1797
Hole Mill (Fife)	Flint Mill	pre 1833
St Ninian's Mill*(W.Loath.)	Bark Mill	C18

* ex malt mill

with better machinery having increased in the country; and from a change in the habits of the people, a larger proportion of flour, and a smaller proportion of meal, are now being used as food. The system of forcibly upholding the rents of mills by means of thirlage begins to be generally laid aside, and with good reason, as this compelling of tenants and dependents to carry their grain to be manufactured at a certain mill, is found to be productive of many inconveniences and fruitless disputes"⁷⁵.

7 : Sinclair, Sir J. "General Report of the Agricultural State and Political Circumstances of Scotland" 2 vols and Appendix 2 vols., Edinburgh 1814 II: 117

Headrick, J. "General View of the Agriculture of the County of Forfar" London 1814. 226

Robertson, J. "General View of the Agriculture of South Perthshire" London, 1794. 51

GBA II 602 Callender, Perthshire

GBA IV111. 349 Kippax, Stirlingshire

8 : Headrick, op.cit. 266

9 : See, for example, SRG GD224/249 "Account of Ironwork used for work to Rickarton Mill" November 4th 1743

10 : SRG GD267/27/166

11 : Anderson, M.L. "A History of Scottish Forestry" 2 vols London, 1907 II:145

12 : For an example of how timber was used see SRG GDM161/24 F. Fergusson to Dr. Hamilton. May 16th 1818

13 : See for example, Handley, J.B. "Scottish Farming in the Eighteenth Century" London 1953

Handley, J.B. "The Agricultural Revolution in Scotland" Glasgow, 1963

- 1 : Buchan, J.W. "A History of Peebles-shire" 2 vols
Glasgow 1925 I 78
- 2 : OSA XIX 427 Kilmany, Fife
- 3 : SRO E 730/35
- 4 : Adam, R.J. (Ed.) "Sutherland Estate Management 1802-16"
SHS 4th Series VIII-IX (1972) I 204
- 5 : SRO GD135/94
- 6 : See, for example, plans in Gray, A. "The Experienced Millwright" London 1806
- 7 : Sinclair, Sir J. "General Report of the Agricultural State and Political Circumstances of Scotland" 3 vols and Appendix 2 vols., Edinburgh 1814 I. 117
Headrick, J. "General View of the Agriculture of the County of Forfar" London 1814 226
Robertson, J. "General View of the Agriculture of South Perthshire" London, 1794, 51
OSA XI 602 Callander, Perthshire
OSA XVIII 349 Kippen, Stirlingshire
- 8 : Headrick, op.cit., 266
- 9 : See, for example, SRO GD224/240 "Account of Ironwork used for work to Rickerton Miln" November 4th 1743
- 10 : SRO GD267/27/188
- 11 : Anderson, M.L. "A History of Scottish Forestry" 2 vols
London, 1967 II.145
- 12 : For an example of how timber was used see SRO GD1161/24
P. Fergusson to Dr. Hamilton. May 16th 1818
- 13 : See for example, Handley, J.E. "Scottish Farming in the Eighteenth Century" London 1953
Handley, J.E. "The Agricultural Revolution in Scotland"
Glasgow, 1963

- 14 : Handley, op.cit., (1953), 38-9
- 15 : Handley, op.cit., (1963), 122
- 16 : SRO GD24/1/648
- 17 : OSA VII. New Monkland, Lanarkshire
- 18 : SRO GD1/16/1
- 19 : SRO GD46/17/59
- 20 : Leslie, W. "General View of the Agriculture of the Counties of Moray & Nairn" London, 1811. 35
- 21 : Thomson, J. "General View of the Agriculture of the County of Fife" Edinburgh 1800 339
- 22 : OSA XIX.426 Kilmany, Fife
- 23 : Somerville, R. "General View of the Agriculture of the County of East Lothian" London 1805 302
- 24 : SRO GD15/832/1,4
- 25 : Thomson, op.cit., 40
- 26 : Based on a comparison of General Roy's Map of Scotland (c.1747) and OS 1st Edition 6"/mile (1867)
- 27 : Dick-Lauder, Sir T. "An Account of the Great Floods of August 1829 in the Province of Moray and Adjoining Districts" Edinburgh, 1830 91
- 28 : The Mill of Winton appears for the last time on William Forrest's map of East Lothian (1799). Whittingehame Mill ceased to function about the time that Whittingehame House was built and its grounds laid out, c.1827. See Shaw, J.P. "The Making of the Landscape: the Eastern Parishes of East Lothian, 1700-1971" Geography MA Dissertation, University of Edinburgh, 1971
- 29 : Kimmerghame East Mill appears as disused on an 1802 plan. SRO RHP197
- 30 : SRO GD50/16/1

- 31 : OSA IX 138 Abernyte, Perthshire
- 32 : SRO GD132/3
- 33 : OSA XI 547 Tulliallan, Fife
- 34 : See, for example, SRO GD10/1234: Mill of Flilarg 1790
The person involved was fined £10.
- 35 : SRO GD72/539
- 36 : OSA XIX 69 Halkirk, Caithness
- 37 : SRO GD71/216/1
- 38 : OSA V.336 Cathcart, Renfrewshire
- 39 : SRO GD71/216/1
- 40 : SRO GD38/1/1194
- 41 : OSA II 125 New Abbey, Kirkcudbrightshire
OSA XIII 258 Kirkpatrick-Fleming, Dumfriesshire
- 42 : OSA XIV 260 Kilfinan, Argyll
SRO E729/8 53 Mill of Gartchonzie, Perthshire
- 43 : Smout, T.C. "History of the Scottish People, 1560 - 1830" London 1969 297
- 44 : SRO E787/22
- 45 : SRO GD83/744
- 46 : SRO GD83/776
- 47 : SRO GD6/2252
- 48 : OSA IX 550 Grange, Banff-shire
- 49 : OSA XVII 407 Turriff, Aberdeenshire
- 50 : OSA XV 450 Alford, Aberdeenshire
OSA XII 203 Kenmay, Aberdeenshire
OSA XVI 474 Deer, Aberdeenshire
- 51 : OSA XIX 436 Dunning, Perthshire
OSA XVIII 485 Trinity Gask, Perthshire
OSA IX 12 Buchanan, Stirlingshire

- 52 : Lamont, Sir N. (Ed.) "An Inventory of Lamont Papers.
1231-1897" SRS LIV (1914) No. 1301
- 53 : OSA XV 502 Kilbarchan, Renfrewshire
- 54 : OSA XVIII 109 Garnock, Stirlingshire
- 55 : SRO GD170/484/2
OSA XII 99 Dalry, Ayrshire
OSA II 71 Galston, Ayrshire
OSA II 125 New Abbey, Kirkcudbrightshire
- 56 : SRO GD50/159
- 57 : OSA XV 605 Foulis Wester, Perthshire
- 58 : OSA XIII 258 Kirkpatrick-Fleming, Dumfriesshire
OSA III 467 Arbirlot, Angus
- 59 : SRO E773/29
- 60 : The three exceptions to the rule being
OSA VII New Monkland, Lanarkshire
OSA VII 290 Mouswald, Dumfriesshire
OSA XIX 427 Kilmany, Fife
- 61 : Act 39 Geo.III Cap.55
- 62 : Handley, op.cit., (1963) 230-1
- 63 : SRO GD24/1/78, /94, /667, /668
- 64 : Farmers' Magazine XVIII (1817) 319
- 65 : "An Act for Encouraging the Improvement of Lands Subject
to the Servitude of Thirlage in that Part of Great
Britain Called Scotland" Copy in SRO GD173/21
- 66 : Sinclair, Sir J., op.cit., Appendix II 278
- 67 : Chalmers, G. "Caledonia" 4 vols., London 1810 II 317
- 68 : OSA V 75 Gordon, Berwickshire
- 69 : OSA I / Dalmeny, West Lothian
- 70 : OSA V 241 Cambusland, Lanarkshire
- 71 : Handley, op.cit., (1963) 249

- 72 : Kerr, R. "General View of the Agriculture of the County of Berwick" London 1809 77
- 73 : Headrick, op.cit., 266
- 74 : Ibid., 226
- 75 : Low, D. "Report on Marchmont Estate" Printed privately, 1819 25-6 (Copy in SRO GD158/725)

FLOUR MILLS

Wheat bread was by no means new to the more affluent citizens of larger burghs. It has already been noted that the Baxter Corporation of Glasgow had had a "wheat mill" in the 17th century and that in other burghs lifting or hauling was carried out by hand. Some wheat had been grown prior to 1730, notably in the better cultivated lands of eastern Scotland, but not until after that date was there an agricultural system capable of producing it on a large scale, or a market wide enough to justify so doing. What is sure is that it was only during the century after 1730 that mills for converting wheat into flour became by any means common.

Technology

The technology of flour mills differed from that of common corn mills in two important respects. Firstly, there was a difference in the type of millstones used: in Scottish corn mills the surfaces of millstones were not cut into furrows but simply roughened to enable them to tear and bruise the grain into coarse meal. To grind flour, however, stones had to be carefully furrowed so that by the time the grain reached the heel it had been cut very fine² (figure 11.1).

FLOUR AND POT BARLEY MILLS

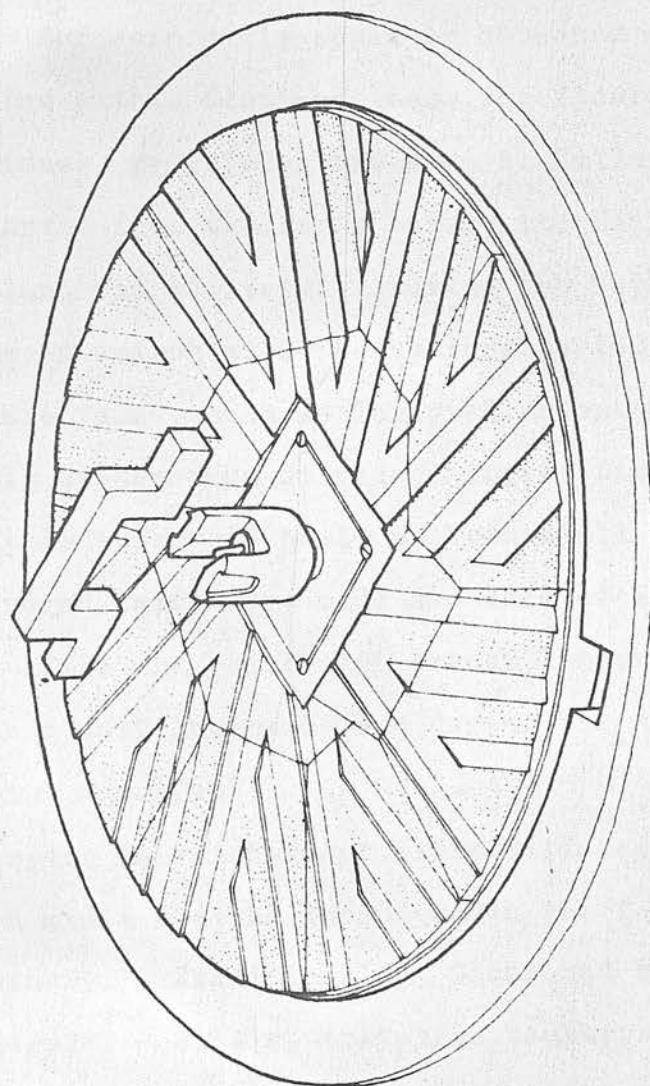
The fortunes of flour and pot barley mills during the century 1730 - 1830 present a marked contrast to those of common corn mills. In 1730 there had been, ostensibly, only one pot barley mill in Scotland (infra p. 42) and no flour mills, but by 1830 machinery had been installed in corn mills, or in mills specifically for flour and pot barley, over much of Scotland.

FLOUR MILLS

Wheaten bread was by no means new to the more affluent citizens of larger burghs: it has already been noted that the Baxter Corporation of Glasgow had had a "wheat mill" in the 17th century and that in other burghs sifting or boulding was carried out by hand¹. Some wheat had been grown prior to 1730, notably in the better cultivated lands of eastern Scotland, but not until after that date was there an agricultural system capable of producing it on a large scale, or a market wide enough to justify so doing. What is more, it was only during the century after 1730 that mills for converting wheat into flour became by any means common.

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11.1

Although no specific reference is made to such stones, they were almost certainly incorporated in flour mills from 1750 onwards and probably in a few earlier cases, such as the Baxter's wheat mill in Glasgow; because of the taste for finely ground barley or pease flour, those cornmills which possessed a second pair of stones often had them dressed in the same manner.

Whereas stones for corn mills could be obtained from one of many quarries within Scotland those for flour mills - French Burr-stones, greystones and blue or Cullen stones - had to be imported from the Paris basin, the Peak District and the Rhineland respectively. During the Napoleonic Wars when the price of French mill-stones rose to £60 a pair local substitutes were found, such as Inverteil stones from Fife³ and Abbey Craig stones from Stirlingshire. Like the French stones the latter type were built up from small pieces.

Over three hundred pairs were made and sold at £12 - £20 per pair, but after the peace with France, imported burr-stones fell to a very low price and demand for Abbey Craig stones all but disappeared⁴.

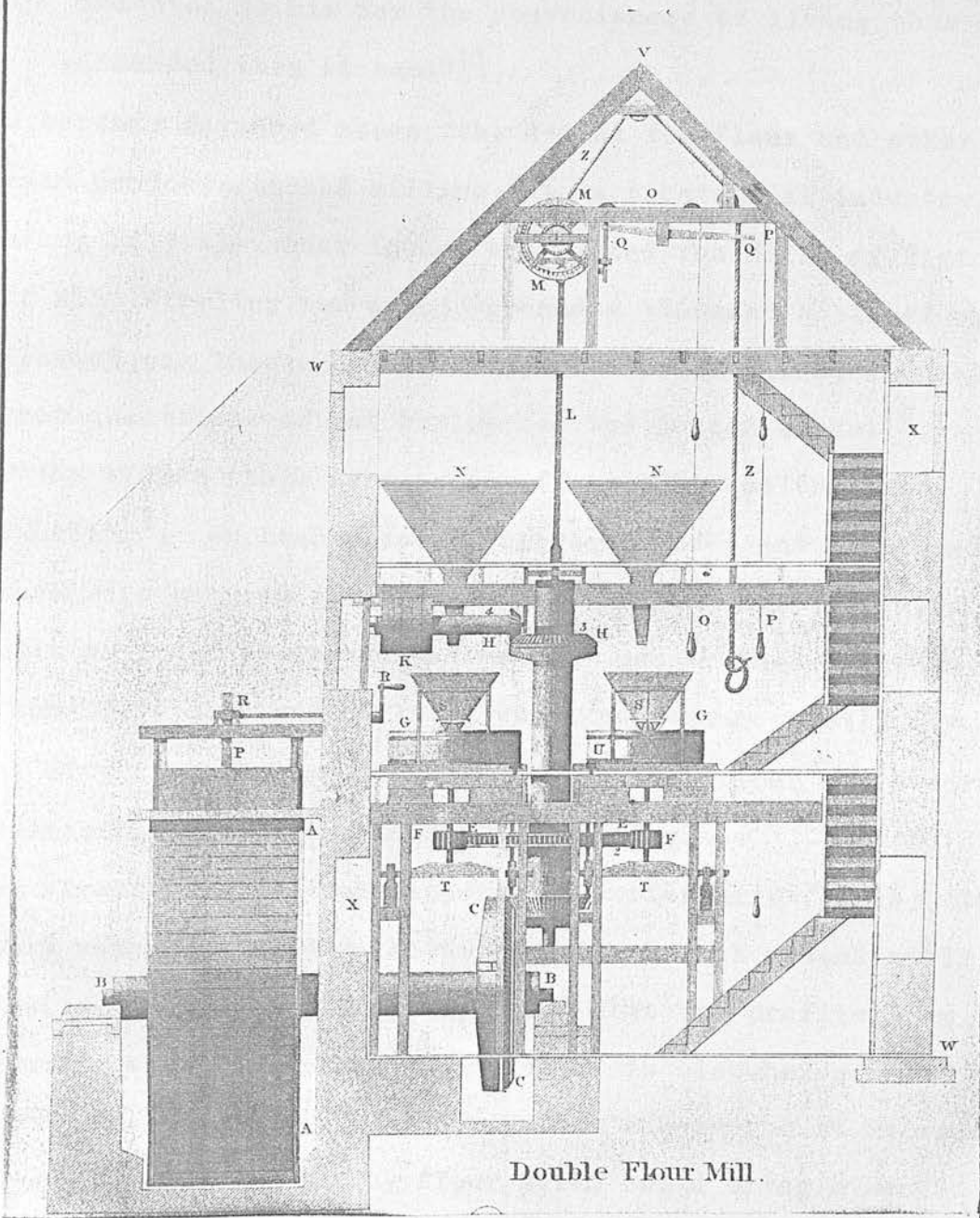
The second respect in which flour mills differed from conventional corn mills was the inclusion in the former of boulding machinery. Traditionally, flour had been sifted by hand in "harps". Simple, tray-like boulders were in use in Europe from the early 16th century, and more sophisticated cylindrical types had been developed before the end of the same century⁵. The cylinder, which was inclined, was lined with brush work and divided into say, five compartments and covered with cloth or wire mesh (boulding cloth) through which flour of different grades passed separately⁶.

The boulting mill installed by 1741 at Bonnington Mills (Edinburgh) was probably of this type; the mill at Invergowrie (Perthshire) certainly had one by the 1780's⁷. Figure 11.2 shows the layout of a typical flour mill of the early 19th century. Developments in the Falkirk area illustrate well not only the changes in technology but also in demand; in 1730 only two hundred bolls of wheat per annum were being made into flour, and that in common corn mills with hand boulting; by the 1790's seven flour mills were grinding seven thousand bolls per annum and boulting by machine⁸. Valuations of two 18th century flour mills are given in Appendix G.

The Market for Flour

By the late 18th century, the taste for, and the ability to pay for, wheaten bread had spread into the countryside⁹; such was the demand for flour that mills were constructed in whatever localities had access to consumers and any district which lacked them, such as Upper Clydesdale, was considered to be at a great disadvantage¹⁰. For the enlightened landowner the construction of a flour mill was the logical sequel to, or incentive towards, a programme of agricultural Improvement; additional income could be derived from providing the means whereby neighbouring heritors could grind their flour. in 1780 Andrew Wight reported that on General Abercromby's Glasshaugh estate (Banffshire):

"fall, lime and dung, has yielded him large crops of wheat in a country where there was none before; and in order to furnish to his neighbours good flour, he has erected a windmill which, tho' expensive, was successful. But this mill not being sufficient to



answer the demand for flour; he has erected another wheat mill, on the only stream of water he is in possession of. Upon the same stream he has erected a mill for pot-barley. His neighbours are much indebted to him for the conveniences of living thus afforded them at hand"¹¹.

In certain favoured areas, the demand for flour and other grain products turned milling into a substantial industry. During 1779 Alexander Young, who rented the Mills of Elgin for £150 Sterling per annum, ground a thousand bolls of wheat, exported one thousand four hundred bolls of barley and made great quantities of pot barley for the London market¹². By the 1790's there were twenty flour mills on the Water of Leith¹³; on Leader Water, between Lauder and the Tweed, there were between twenty and thirty mills, some recently built to grind wheat and barley¹⁴. One mill near Perth ground five thousand bolls of wheat per annum, mostly for the city¹⁵, while by 1800, Fife's fourteen flour mills were processing some forty thousand bolls of wheat¹⁶. By 1813, the already substantial capacity of Forfarshire (Angus) flour mills was considered to be too small and with demand still growing, fears were being expressed that the profits from grinding went to market-orientated mills elsewhere; more mills were planned¹⁷. As David Loch discovered at Melrose, the commerce generated by flour mills could bring other benefits too:

"The Duke (of Buccleuch) has erected fine ... mills here, which enables the farmers to drive their meal and flour to the Edinburgh and Dalkeith markets, and gives the return carts an opportunity of bringing

coals, lime, timber, and all sorts of goods from the Lothians, at a moderate charge: by this means Melrose is supplied with coal and all other necessities as cheap as if they were within four miles of the coal-pits or Port of Leith"¹⁸.

The construction of flour mills helped the progress of the Agricultural Revolution, generated capital in rural areas and helped feed the growing concentrations of population in urban communities, both within and without Scotland. The addition of flour-milling machinery to existing corn mills almost guaranteed the survival of the latter, although in some areas pressure from the industrial users of water power brought a change in use. In rural areas at least, wheat was generally milture free, a fact which further encouraged its growth once a suitable mill was built. For the same reason, however, large quantities of wheat found their way to market unground, to be milled eventually at urban mills.

No comprehensive source is available to show the distribution of flour mills during the period, but most of those which appear on the first Ordnance Survey maps were probably in existence by 1830. Account should also be taken of another element in Scottish grain milling, for besides flour mills; those for pot barley were experiencing a similar growth.

POT BARLEY MILLS

After the construction of the first pot barley mill at Saltoun (East Lothian) the process used remained a closely guarded secret and the mill enjoyed a monopoly for some forty

years. According to one story, the miller at the neighbouring Mill of Keith hit upon the idea of plying a worker from the barley mill with alchohol and succeeded in extracting the necessary information¹⁹. Whether or not the monopoly was broken in quite this manner, the secret did eventually leak out and soon became general knowledge. Subsequently, the use of pot barley mills became widespread.

Technology

Although pot barley could be prepared by hand, with a mortar and pestle, the method was very laborious and never completely separated the husk from the kernel; a mill could produce pot barley much quicker and more effectively, with substantially less labour. The early mills consisted of two horizontal millstones, placed one above the other, as in an ordinary meal mill. The lower stone revolved within a circular wooden case, the circumference of which was covered with perforated sheet iron, through which dust and small "seeds" could escape. This type of mill continued to be built until the 1770's when a more efficient type was introduced, incorporating a vertical edge-running stone, instead of a horizontal one²⁰. In either form, it could be added to any well powered mill at no great expense. At Skaithmuir Mill (Banffshire) the barley mill was to be driven off the existing pit wheel, round the edge of which was fixed a ring of cast-iron cogs. These engaged with the wooden teeth of a wood and iron spur wheel which, through a 4 $\frac{1}{4}$ " square iron lying shaft, drove a barley stone 3'10" by 9"²¹.

Incentives to Building

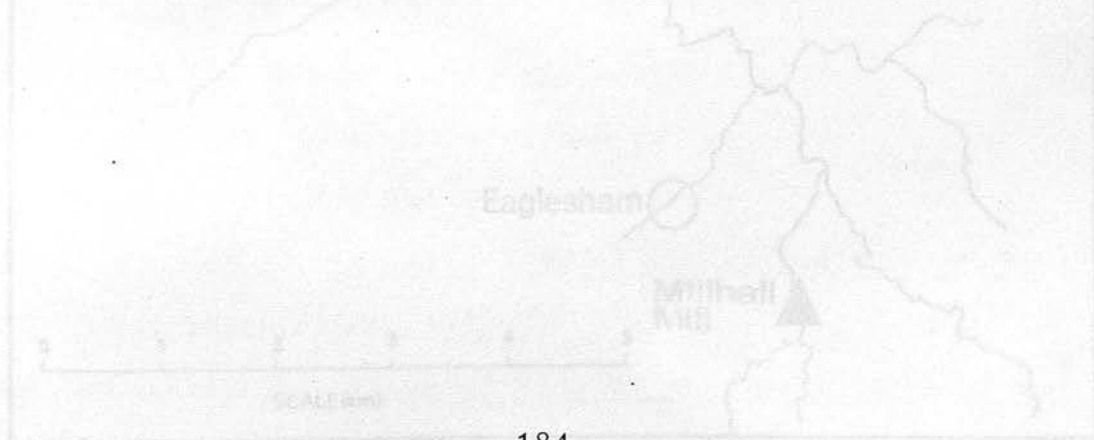
From the miller's point of view, the addition of a barley mill to the machinery of a corn mill could offer an additional source of income, particularly useful in that the preparation of pot barley, unlike oatmeal, was paid for in cash not kind²². Furthermore, by manufacturing this commodity, the miller was compensated for any reduction in oats grown or ground and could profit from the processing of barley which might otherwise have found its way to a brewery, distillery or market, unground. In some places, barley and bere were made into pot barley as a preliminary to grinding it into flour on flour mills²³. Obviously, a corn mill which lacked such equipment was in a relatively unfavourable position.

For the farmer and, when involved, the grain dealer, the sale of pot barley could produce a useful source of income. A greatly improved road system and a network of coastal and overseas shipping routes were used to good effect in transporting not only pot barley, but also flour and oatmeal and, to a large extent, the markets for the three commodities coincided. Two Kincardineshire mills, using one thousand three hundred bolls per annum, sent most of their produce to the Forth ports²⁴; from Currie (Edinburgh) pot barley went to Glasgow, whence some was exported to the West Indies, to be used as food for slaves²⁵. A pot barley mill in Stoneykirk parish, Wigtownshire, was built with a view to supplying the Liverpool market²⁶ and the four hundred bolls produced annually by one Angus barley mill was shipped to London²⁷. Reference has already been made to Alexander Young exporting great quantities of pot barley to the same

destination from Elgin (infra 180). Fife mills, which by 1800 were milling 104,000 bolls of oats, and 40,000 of wheat, also produced 25,000 cwt. of pot barley per annum, from 15,000 bolls of barley²⁸. Like the flour mills with which they were often built, pot barley mills helped to assure the survival of many rural corn mills, bringing money to rural areas and providing an important element in the diet of Scotland's increasingly urban population. Furthermore, for many years Scotland held a virtual monopoly of pot barley making in Britain and therefore was able to exploit markets in England, Ireland and the Colonies.

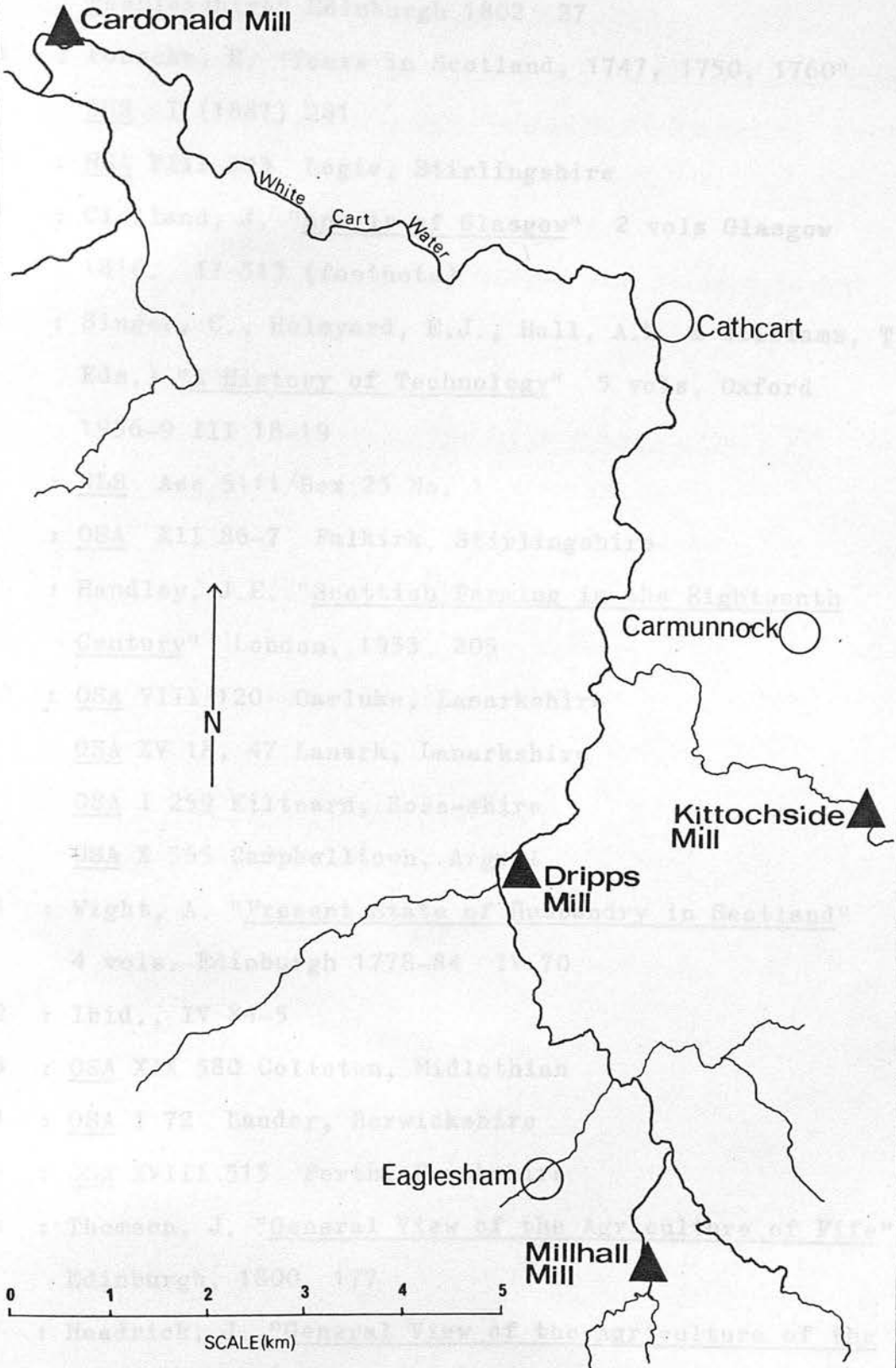
A Note on Pease Ovens

One of the more unusual purposes to which water power was put in Scottish grain milling was the pease oven, devised at some time before 1782 by John Watt or Wark at the Mill of Dripps (Renfrewshire) and applied by several other millers nearby (figure 11.3). According to Semple, Wark built a "kiln for drying peas, with an engine which goes by a water wheel, always stirring and turning peas, and will dry about five pecks of peas in the space of one hour"²⁹. As far as is known, no more is heard of pease ovens after 1795 and the invention never spread outside the immediate area.



11.3

GLASGOW



- 1 : Vide infra p. 42
- 2 : Findlater, C. "General View of the Agriculture of Peeblesshire" Edinburgh 1802 27
- 3 : Pococke, R. "Tours in Scotland, 1747, 1750, 1760" SHS I (1887) 281
- 4 : NSA VIII 223 Logie, Stirlingshire
- 5 : Clelland, J. "Annals of Glasgow" 2 vols Glasgow 1816. II 513 (footnote)
- 6 : Singer, C., Holmyard, E.J., Hall, A.R. & Williams, T.I. Eds.) "A History of Technology" 5 vols, Oxford 1956-9 III 18-19
- 7 : NLS Acc 5111/Box 25 No. 1
- 8 : OSA XII 86-7 Falkirk, Stirlingshire
- 9 : Handley, J.E. "Scottish Farming in the Eighteenth Century" London, 1953 205
- 10 : OSA VIII 120 Carluke, Lanarkshire
OSA XV 18, 47 Lanark, Lanarkshire
OSA I 259 Kiltarn, Ross-shire
OSA X 565 Campbelltown, Argyll
- 11 : Wight, A. "Present State of Husbandry in Scotland" 4 vols. Edinburgh 1778-84 IV 70
- 12 : Ibid., IV 84-5
- 13 : OSA XIX 580 Colinton, Midlothian
- 14 : OSA I 72 Lauder, Berwickshire
- 15 : OSA XVIII 515 Perth, Perthshire
- 16 : Thomson, J. "General View of the Agriculture of Fife" Edinburgh, 1800 177
- 17 : Headrick, J. "General View of the Agriculture of the County of Forfar" London, 1814 266

- 18 : Loch, D. "A Tour through Most of the Trading Towns and Villages of Scotland" Edinburgh, 1778 45
- 19 : MacKenzie, W.C. "Andrew Fletcher of Saltoun. His Life and Times" Edinburgh 1935 304
- 20 : Sinclair, Sir J. "General Report of the Agricultural State and Political Circumstances of Scotland" 3 vols and Appendix, 2 vols. Edinburgh 1814
- 21 : SRO GD58/18/42
- 22 : In Kirkoswald parish, Ayrshire, the going rate was 1s 8d to 2s per boll:
OSA X 491
- 23 : Keith, G.S. "General View of the Agriculture of Aberdeenshire" Aberdeen, 1811 252
- 24 : OSA XIII 4 Inverbervie, Kincardineshire
- 25 : OSA V 313 Currie, Midlothian
- 26 : OSA II 51 Stoneykirk, Wigtownshire
- 27 : OSA V 145 Menmuir, Angus
- 28 : Thomson, op.cit., 302
- 29 : Crawford, G. (revised Semple, W.) "The History of Renfrewshire" Paisley, 1782 4

URBAN GRAIN MILLS

During the century 1730 - 1830 the urban sector came to represent a much greater proportion of Scotland's population than it had previously done: the drift from the land has already been referred to; the increase in the demands put upon urban mills was such that although most were re-built on a much larger scale, it was still necessary to enlist the help of the better equipped rural mills in preparing meal, flour and pot barley for the rapidly growing number of urban consumers.

Mill Rebuilding : Dumfries, Perth and Alloa.

In 1730, most burgh mills were equipped to grind only meal and malt for the small thirls which they served. With the introduction of machinery to prepare flour and pot barley and the growth of large domestic markets for these commodities, burghs found it necessary to instal machinery suited to such purposes, thus providing the mills with an extra source of income. As early as 1705, Dumfries burgh council engaged a Mr Mathew Frew to build "ane sufficient miln, capable of grinding malt, meal, flour and all other sorts of grain". In 1707, the new mill was let, but not until 1742 was a wheat mill installed and a proper barley mill had to wait until even later¹. The mills were rebuilt in 1769, to a design by John Smeaton, at a cost of £633; they were accidentally burnt down in 1780, but the machinery was saved and, with a sum of £1,530 retrieved in insurance, this went a long way towards recouping the loss². Within a year they had been rebuilt yet again, this time to a design

by Andrew Meikle³. By the 1790's, the mills were yielding £400 Sterling per annum in rent; in 1825, the flour, barley and meal mills were renting at £220, £60 and £171 respectively, a total of £451⁴.

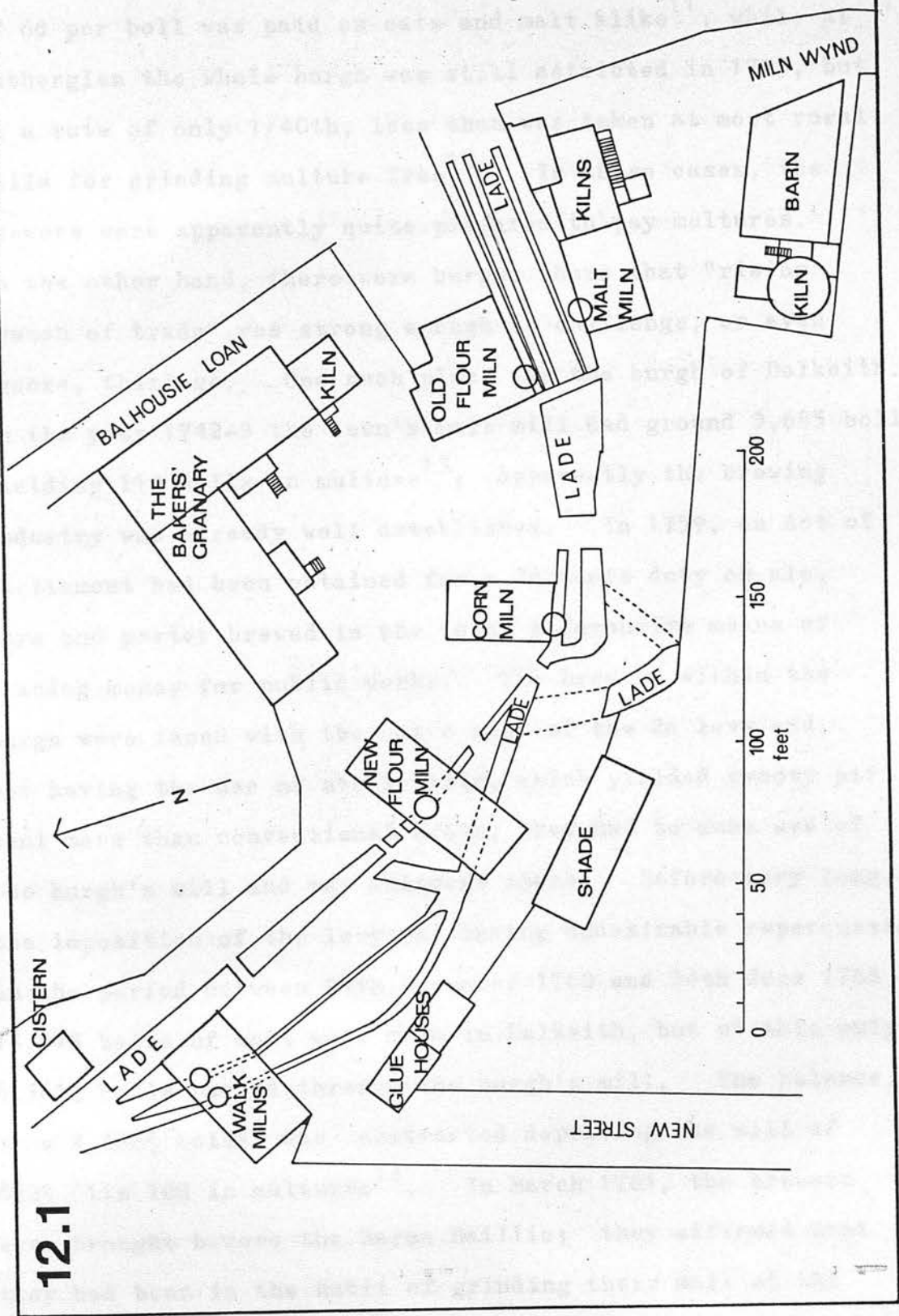
The burgh mills of Perth, which incorporated separate malt, corn and flour mills, were rebuilt c. 1787, and a second flour mill added⁵ (figure 12.1). By the 1790's besides grinding malt, bere, pease and oats, the mills made pot barley and ground sixty bolls of flour per day, two thirds of which was for local use. The tenants, Messrs Ramsay, Whittel and Co, rented the mills for about £800 per annum. It is interesting to note that at this period, the bakers still paid multure⁶. Further building, or rebuilding, took place between 1805 and 1809 with the construction of the Lower City Mill in which oatmeal was produced⁷.

The mills of Alloa were rebuilt in 1735-6 at a cost of nearly £2,000 Scots, utilising water from Gartmore Dam⁸; in the late 18th century they were totally rebuilt in a mere twelve months to a design by George Meikle. This "fine set of mills", 93ft x 31ft and 32ft high, was equipped to grind wheat, oats, malt and pot barley, at the rate of four hundred bolls per day when necessary; two internal 19ft diameter water-wheels drove all the machinery⁹.

Malt Milling and the Rise of Brewers

The long hard struggle to uphold thirlage over brewers had not yet come to an end by 1730. The power of a burgh to enforce thirlage over brewers depended on the number and economic strength of the brewers, the capacity of the machinery in a burgh's mills and the determination of a

12.1



burgh's council or feudal superior to uphold thirlage. At Linlithgow, the brewers were still astricted in the 1790's and paid 1/16th in multures¹⁰; at Irvine, a converted multure of 6d per boll was paid on oats and malt alike¹¹, while at Rutherglen the whole burgh was still astricted in 1793, but at a rate of only 1/40th, less than was taken at most rural mills for grinding multure free¹². In these cases, the brewers were apparently quite prepared to pay multures. On the other hand, there were burghs where that "rising branch of trade" was strong enough to challenge, or even ignore, thirlage. One such place was the burgh of Dalkeith. In the year 1742-3 the town's malt mill had ground 3,685 bolls yielding 119 bolls in multure¹³; apparently the brewing industry was already well established. In 1759, an Act of Parliament had been obtained for a 2d Scots duty on ale, bere and porter brewed in the town, a favourite means of raising money for public works. The brewers within the burgh were faced with the extra cost of the 2d levy and, not having the use of steel mills, which yielded twenty per cent more than conventional mills, they had to make use of the burgh's mill and pay multures there. Before very long, the imposition of the levy was having undesirable repercussions: in the period between 24th December 1760 and 24th June 1761 14,948 bolls of malt were made in Dalkeith, but of this only 6,361½ bolls passed through the burgh's mill. The balance, some 8,586½ bolls, was abstracted depriving the mill of £229 11s 10d in multures¹⁴. In March 1761, the brewers were brought before the Baron Baillie; they affirmed that they had been in the habit of grinding their malt at the mill and that some had been ground elsewhere. Having admitted

to this, they were asked to pay abstracted multures but, not content with this judgment, the defenders presented a bill of advocation before the Court of Session and, in June 1762, obtained an interlocutor from Lord Auchinleck to the effect that malt made within the thirl, but sold outside it, had never been subject to thirlage. Seeking a quick settlement, the brewers, whilst still not acknowledging that they were thirled for malt, offered to grind at the burgh's mill as formerly, on condition that the Duke of Buccleuch (as pursuer and feudal superior) erected steel mills and prohibited the sale of "foreign" ale. The Duke responded by starting a process against the retailers who had "imported" ale, while refusing to drop that against the brewers. His next step was to turn towards the terms on which the brewers were thirled by their feu charters. However, despite the production of several such documents, and Acts of the Baron Court dated 1626, 1664, 1701 and 1705, he failed to convince the Court of Session of the existence of anything other than a thirlage of grana crescentia, a judgment which was upheld in interlocutors of March and July 1765. In August of that year, the pursuers claimed that the tacksmen of the mills had, in the past few years, installed steel mills "to be wrought by water" but had taken them down again as the maltsters and brewers had failed to make use of them. A further interlocutor, dated 23rd January 1766, upheld the brewers' freedom to grind their malt wherever they chose and on 17th June 1766, in what appears to have been the last judgment in the case, only one small concession was made to the pursuers who were asked to pay the defenders for the expense of extracting a decree¹⁵.

In 1752, the Burgh of Perth brought an action against Alexander Clunie and others, who had established a brewery outside the burgh and at which Clunie ground his own malt to the loss of the burgh mills. From the brewery, he imported beer into the burgh, but Perth being a royal burgh, its authorities lacked the power of a feudal superior in a burgh of barony and could, therefore, do nothing to prevent Clunie from so doing¹⁶. In 1824, Alloa was still attempting to maintain a thirlage of malt, although the Carsebridge and Grange breweries and one major distillery had been granted exemption¹⁷.

In Glasgow, the town council continued to fight their losing battle against the brewers and their steel mills. Efforts were made to improve the efficiency and reliability of the town's malt mills: in 1741, millers from the malt mill and corn mill at Townhead commissioned Robert Meikle (elder brother of Andrew) to prepare a scheme whereby the mill's water supply might be improved. The scheme was accepted and carried through by the corporation¹⁸. In 1744 the town had made trials of steel mills at one of its own water mills¹⁹, but when, in 1760, the multures of the town's four malt mills were let (at 5,600 merks), permission was granted for agreements to be made, whereby individuals could use their own steel mills²⁰. In 1771 one of the mills, at Clayslap, was granted to the bakers, in perpetual feu; the demands made on the burgh's malt mills had apparently diminished sufficiently to permit such a sale. More positive evidence appeared in the next decade. On 7th June 1780, it was noted that, although exposed to roup, the malt mills had not been set for two years past. Their unattractiveness, it was claimed,

lay in the reduction in multure yields resulting from the indulgence shown in letting people in Glasgow and Gorbals use their own steel mills, instead of the city's water mills, to which they were thirled²¹. By 1795 Subdean Mill had been converted to grind cudbear²², (vide infra 505) and in 1809 Partick Mill was sold to the Slit Mill Company²³ (vide infra 617) leaving only the Town Mill and Provan Mill in the hands of the corporation.

Thirlage and the Baxters

The brewers were not the only "rising trade" to disrupt thirlage. At one time Perth had twenty-four bakers, but a "rigid exaction of thirlage multure" drove them into the suburbs, notably to Bridgend. By the 1820's there were only six bakers left in Perth, but six in Bridgend and more than ten in other suburbs; the grist left to the burgh mills was hardly enough to pay for the counter-obligation to keep up the mills²⁴. In many burghs it was the bakers, or baxters, who rented the burgh mills, for by so doing, they could exempt their members from paying multures, while continuing to levy them on whomsoever else should make use of the mills. If the tack fell into the hands of other parties, however, the bakers would often do their utmost to avoid paying multures by grinding their wheat elsewhere.

In 1750 the Mills of Baldovan (Angus), the property of the Burgh of Dundee, were let to the incorporation of bakers for a period of eleven years at a rent of £63 per annum. In 1761, at the termination of the lease, the mills were re-let, but not to the bakers, who had subsequently expressed their disapproval by denying that the mills had a right of thirlage

and by grinding their wheat elsewhere without paying abstracted multures. Only after the magistrates had brought an action before the Court of Session did the bakers grudgingly recognise the thirlage. This tack, in turn, also expired and the bakers succeeded in regaining control of the mills, on a nineteen-year tack, at £91 per annum. All their doubts as to the validity of the thirlage were suddenly dispelled and it was firmly enforced throughout the bakers' tenancy. No sooner had the tack expired, however, than the bakers were once again contesting the burgh's right of thirlage over them. Seeking to obtain confirmation of this right, the town council brought an action before the Sheriff Court; the bakers countered by asking that an action be brought on their behalf for commutation of thirlage under the recently passed Act. While the opposing parties argued the pro's and con's of their respective cases, the magistrates of Dundee raised a further case before the Burgh Court, this time against several individual bakers, for abstracted multures; the bakers' rejoinder was to raise an action of declarator and damages before the Court of Session, questioning the adequacy of the mills for grinding wheat and the capacity of the mills in meeting the needs of the thirl. On 27th November 1801, this action and those from the Burgh and Sheriff Courts came before the Court of Session. Judgment was given on 23rd May 1804, when the Court found that the incorporation of bakers had a right to insist on purchasing their thirlage. As to the nature and extent of the thirlage, however, the Court failed to resolve any of the points at issue and, after dragging on for some time, the case was ultimately abandoned.

Meanwhile the bakers had obtained, at a greatly increased rent, another nineteen-year lease of both mills and thirlage to run from Martinmas 1804. Once again the bakers strictly enforced the thirlage, even to the extent of raising actions against those who failed to comply with it. When in 1823 the lease expired, the bakers threatened to resurrect the old court actions and press for commutation should the lease to them not be renewed. As it happened they were out-manoeuvred by one Alexander Clark, who offered the preposterously high rent of £502 per annum, only £2 above the bakers' final bid. Clark was the owner of "very complete and efficient" steam-powered flour mills in Dundee itself and his motivation in taking on a lease of the then almost derelict Baldovan Mills can only be construed as wishing to see them run down further to the benefit of his own mill. While conceding that as a mere tenant he could not alter existing thirlages to Baldovan Mills, he "considered it would be more advantageous" for restricted flour to be ground at his own mill and, in an effort to obtain the bakers' concurrence, he offered to grind their wheat at his mill for 1s 9d per boll, instead of 2s 3d levied in multure at Baldovan. Full multure would still be taken from those grinding at the latter and those who started by grinding at one mill or the other would have to keep to that mill for the rest of the year. In effect Clark was attempting to establish a thirlage of his own at rates well above those prevailing at most free mills²⁵. Apparently he had underestimated the bakers. In the first year of the lease they abstracted between 3,000 and 5,000 bolls of wheat; in reply to processes raised by Clark, they attacked him for not keeping mill servants, locking the doors

and failing to take up the burgh's offer of financial aid in rebuilding the mills. The capacity of the mills, at 14,000 bolls per annum, fell far short of the 25,000 bolls which the bakers, by their own calculations, used each year and as long as the Mills at Baldovan were inadequate they were not obliged to grind there. On 7th February 1828, after three judgments alternately for and against the millers had been overturned, it was finally decided that the mills were inadequate and that the multures were not, therefore, payable. The bakers also tried to gently twist the arm of their former adversary, the burgh council. In a memorial c. 1825, they pointed out that the 16,000 bolls that they had to grind for the thirl's 15,000 inhabitants would yield a profit for Clark of only £281 7s once his rent had been paid. In place of multures a tax was proposed on wheat and flour entering the town, which tax the bakers would farm at £100 Sterling per annum. The town could then sell the mills, valued by the bakers at £7,000, exclusive of thirlage.

It would appear that the bakers were not far wrong in their calculations of Clark's income; at that stage the bakers were already a source of financial embarrassment to him and by 1827 they had led him to bankruptcy. By this time the town council was anxious to dispose of so troublesome a property, but when the mills were exposed to roup, with thirlages, the bidding failed to reach the reserve price of £5,000 let alone the £7,000 at which they had been valued without thirlage by the bakers. Five months later, the bakers obtained a feu of the mills at the knockdown price of £4,000. The bakers and their astriction continued to

pose problems and Baldovan Mills were still the subject of legal proceedings in the 1860's²⁶.

In Glasgow, where the bakers had their own thirlage-free mills, the relationship between bakers and burgh was, by way of contrast, exemplary. While this arrangement led to an unusually great dependence upon malt at the burgh mills, it also saved the council from the troublesome disputes which burghs such as Dundee experienced with their bakers. When in 1771 the demands on the bakers' Partick Mill became too great no confrontation arose with the burgh; instead, the bakers purchased the town's malt and snuff mill at Clayslap and had it fitted out as a flour mill²⁷. In 1800 a combination of dry weather and ever growing demand for flour, not only to feed the inhabitants but also to victual ships, led to a situation where there was not so much flour in the city as would feed the inhabitants for one day. Wheat had to be carted as far as Alloa for grinding²⁸. Requirements had finally outgrown the productive capacity of the local water mills. In the following year, Clayslap Mill was extended and a 32hp steam engine installed for use during dry spells²⁹. Water and steam power worked in a complementary, not competitive, way. The charge for grinding, which had been a mere 6½d in 1780, was still low in 1816 at 13½d inclusive of cartage³⁰. Glasgow's grain mills were a credit to both bakers and town. James Cleland, writing in 1816, spoke of them in the following terms:

"The Clayslap Mills, it is believed, are not inferior to any in the Empire, in point of situation, management and the internal arrangements of the machinery. The

principal mill has four floors; is 207 feet long, and 41 feet wide, within the walls; it contains three water-wheels, each 17 feet diameter, and 6 feet 6 float-boards; has fifteen pairs of stones, double motion. on one floor; four bolting and two sheiling machines. The mills at Partick contain four water-wheels, seven pairs of stones, two bolting and one sheiling machine so that there are seven water-wheels, twenty-two pairs of stones, six bolting and three sheiling machines, connected with the establishment. There are also four granaries; two of these are four storeys high, each 140 feet long and 35 feet wide. The kilns, and the other buildings, are proportionate to the mills. These mills are on a scale capable of grinding 3,000 bolls of wheat per week, or 156,000 per annum. In 1815, there were upward of 90,000 bolls manufactured. The granaries are calculated to contain from 30 to 35,000 bolls of grain. The millstones used in these premises are from 4 feet 8 inches to 4 feet 10 inches diameter, and $12\frac{1}{2}$ inches thick. They are built on the spot, with small stones from the neighbourhood of Bordeaux, called French Burrs; they are very hard, free from sand, and are joined together with stucco cement, within an iron hoop. The grounds connected with these works extend to about fourteen acres. The value of the whole may be estimated at somewhat between 45,000 l. and 50,000 l."³¹

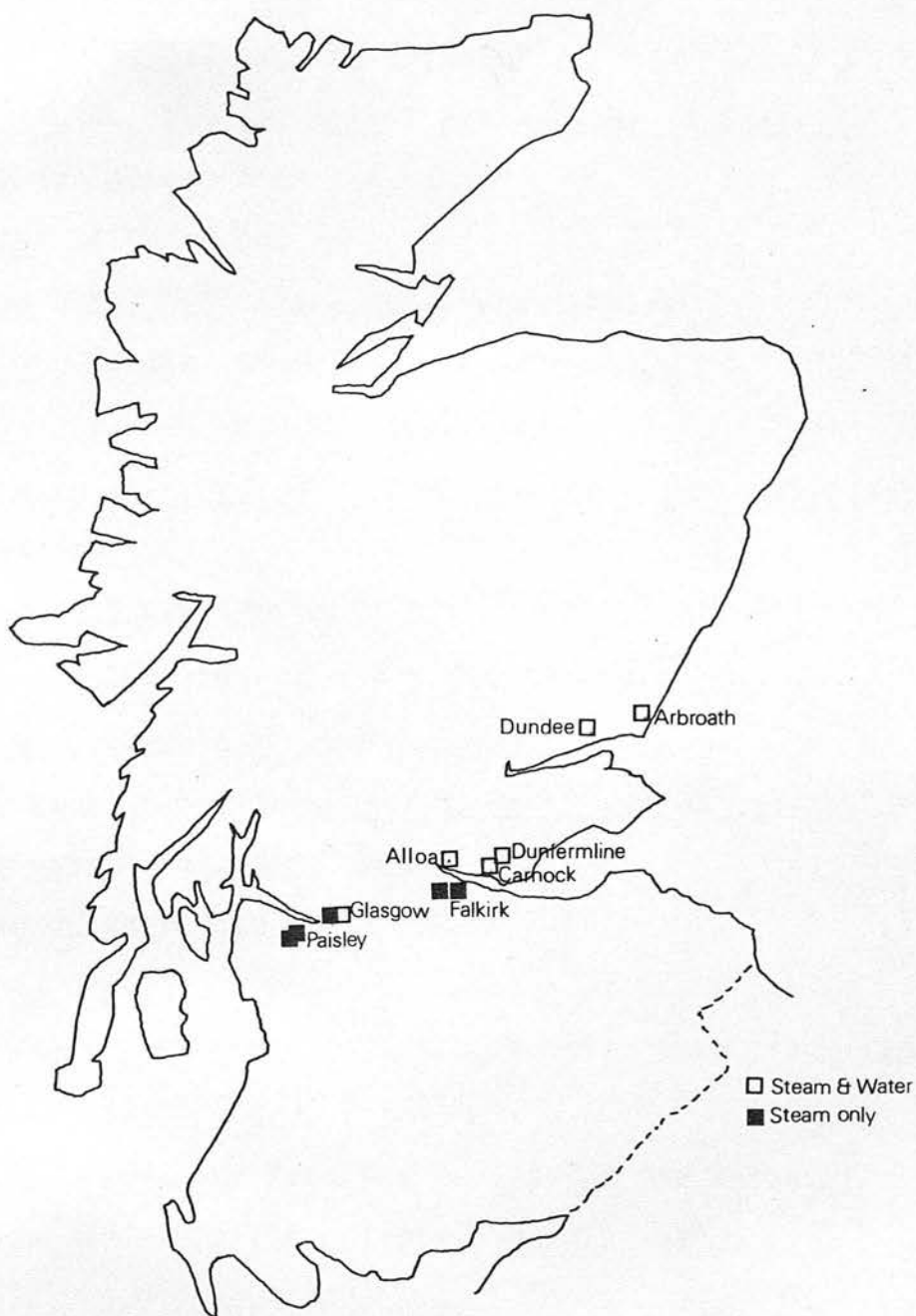
The Glasgow bakers, free from thirlage to burgh mills, enjoyed a peaceful prosperity in marked contrast to the hundred years of conflict between their brethren at Dundee and the authorities of that town.

Competition from Steam

Reference has already been made to two steam-powered mills; only very rarely did the need for them arise. Some were built in already large communities where rapid growth in the textile industries had boosted the population to such an extent that their needs could no longer be met by water-powered mills alone. In other cases water-power was only available in small quantities, or at a great cost, because of competition from other users. Figure 12.2 shows the distribution of steam grain mills prior to 1830. Paisley, where two steam-powered grain mills had been built by 1812³², was already big enough in 1782 to support two large water-powered mill groups: Seedhill, built in 1759, incorporated two corn mills, one malt mill, two flour mills and three kilns; and Saccel Mill, around which had grown up the suburbs of Paisley, had flour, malt and barley mills³³. Even these, however, were not sufficient to meet demand after the introduction of steam-powered cotton spinning had greatly augmented the town's population. Being near sea level, in an area with many industrial users of water-power, Paisley was not in a position to erect new water mills.

Similar circumstances operated at Dunfermline and Arbroath. The mills at Alloa and Falkirk, while not in textile producing centres, were in areas poorly endowed with water power. Alloa's mill had to rely on an artificial water course, which first had to serve, inter alia, the local coal works. Even so the steam engine was installed not to replace, but only to supplement, water power. Falkirk's growth was closely tied to that of the iron industry, which had already occupied all the best falls in the area, leaving no alternative to using steam.

12.2



Only after the possibilities of using water power had been exhausted was the use of steam power resorted to. As later chapters will show, grain milling was not alone in this respect.

- 1 : DSB V 174 Dumfries, Dumfriesshire
2 : MSA 1741 315 Perth, Perthshire
3 : DSB VII 159 Irvine, Ayrshire
4 : DSB VII 159 Irvine, Ayrshire
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6 : DSB VII 159 Irvine, Ayrshire
7 : DSB VII 159 Irvine, Ayrshire
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- 1 : McDowall, W. "History of Dumfries" Edinburgh. 1867 544-5
- 2 : Ibid., 685
- 3 : Ibid., 686
OSA V 119 Dumfries, Dumfriesshire
- 4 : McDowall, op.cit., 760-61
- 5 : SRO RHP125 (1787)
- 6 : OSA XVIII 515 Perth, Perthshire
- 7 : Butt, J. "The Industrial Archaeology of Scotland"
Newton Abbot, 1967 42
- 8 : SRO GD124/17/288
- 9 : OSA VIII 592 Alloa, Clackmannanshire
- 10 : OSA XVI 556 Linlithgow, West Lothian
- 11 : OSA VII 169 Irvine, Ayrshire
- 12 : Ure, D. "The History of Rutherglen & East Kilbride"
Glasgow 1793 117
- 13 : SRO GD224/288/1
- 14 : SRO GD224/375
- 15 : SRO GD224/375
- 16 : Morison, W.M. "Decisions of the Court of Session"
36 vols. Edinburgh 1820 III 1986
- 17 : SRO GD124/17/467
- 18 : SBRs "Extracts from the Records of the Burgh of
Glasgow" VI (1739-59) Glasgow 1911 92-3, 110, 140-1
- 19 : Ibid., 174
- 20 : SBRs "Extracts from the Records of the Burgh of
Glasgow" VII (1760-80) Glasgow 1912 15
- 21 : Ibid., 599
- 22 : SBRs "Extracts from the Records of the Burgh of
Glasgow" VIII (1781-95) Glasgow 1913 695

- 23 : SBRs "Extracts from the Records of the Burgh of Glasgow" X (1809-22) Glasgow 1915 15
- 24 : SRO GD205/2
- 25 : At Stockbridge Mills, Edinburgh, for example, regulars were charged only 1s 3 $\frac{3}{4}$ d per boll, inclusive of cartage to and from the mill.
- 26 : SRO GD205/2
- 27 : Clelland, J. Annals of Glasgow" 2 vols., Glasgow 1816 II 513
- 28 : Ibid., 515
- 29 : Ibid., 513
- 30 : Ibid., 515
- 31 : Ibid., 514
- 32 : Wilson, J. "General View of the Agriculture of the County of Renfrewshire" Paisley, 1812 266
- 33 : Crawford, G. (Revised Semple, W.) "The History of Renfrewshire" Paisley, 1782 273, 289

BREWING AND DISTILLINGThe Industrialisation of Brewing

Although for several centuries the brewing of ale had been a feature of both rural and urban life in Scotland, it was only in the 18th century that it began to take on the proportions of a factory based industry. The individual, brewing small quantities for private use, suffered firstly from the imposition of malt taxes, then from other legislation such as the Sale of Beer Act (1795), which required the licensing of premises for the manufacture and sale of beer. Reference has already been made to the increasingly powerful place held by brewers in Scottish burghs and to the urbanisation which, by concentrating demand in the towns, favoured the development of larger units of production. In 1765 James Rigg of the Marischal Street Brewery set up Aberdeen's first "common" or "public" brewery which, allegedly, brewed beer "both at a cheaper rate and of a better quality" than the inhabitants of Aberdeen could brew themselves. When the brewery was set up almost every family in the town brewed its own ale, but within fourteen years the practice had almost disappeared, and five or six breweries had been set up on the same lines as Rigg's¹. Nor was the process of centralisation confined to the cities: according to Singer, brewing in Dumfriesshire had fallen "into a few hands" by 1812².

Brewing, Distilling and Agricultural Improvement

As demand increased, so did agriculture's ability to supply grain; with improved techniques bere and oats were replaced by higher-yielding strains of barley which were particularly

favoured on account of their finding a ready sale for pot barley making, or to brewers and distillers for malt. In Stirlingshire, for example, it was said that the many large distilleries "are of advantage to the district, by procuring a ready sale for barley; and the culture of barley is undeniably an important article in the rotation of crops, as it is always accompanied by a rich addition of manure, and a succeeding rest under a crop of ameliorating grasses"³. Many Improving landowners chose to establish towns and villages, partly with a view to resettling those displaced from the land and partly to absorb the products of the new agriculture⁴. Not surprisingly, the establishment of a brewery was a common feature of these new communities: it provided a market for locally grown barley, offered employment to some of those who had been forced off the land and enhanced the estate's rental. Sir George Ross of Pitkerie built a brewery (which still survives) out of his own money as part of his replanning of Cromarty⁵; the brewery at Gatehouse (c.1784), while probably a private venture, had the backing of the village's founder, James Murray⁶. That most famous of improvers, Cockburn of Ormiston, built maltings, a brewery and a distillery which, under the management of Alexander Wight, made pale malt, "high flavoured" ale and whisky⁷. Despite the "risk" to the morals of the cotton mill workers, a brewery was added to Catrine village about 1795⁸. Banff, Grantown and Thurso, all planned settlements, had breweries built c.1750, 1780 and in 1798 respectively⁹.

Brewing Technology

These large units of production often necessitated the intro-

duction of power to drive machinery. The first operation, malting, required none in itself but once malted, barley had to be ground. While brewers remained thirled, the process was carried out at whichever mill held the astringency; from the early 18th century, with the introduction of steel mills, thirlage was gradually broken and mills installed in breweries. Water power was definitely used for this purpose at Gatehouse and at Gilcomston Brewery, Aberdeenshire¹⁰, while at Annan (Dumfriesshire), Cambus (Clackmannanshire) and St Vigeans (Angus) its use seems probable¹¹. However, in the predominantly urban setting of breweries readily available water power was the exception rather than the rule: Gatehouse brewery could utilise the cotton mill lade and Gilcomston stood on the site of a corn mill which had been occupied as a distillery c.1750 - 1770. Other breweries had to use hand operated mills or utilise water-powered malt mills elsewhere: the brewers of Bo'ness, for example, used malt mills on the River Avon 2½ km away¹², while the Crieff brewery, founded in 1791, probably used the nearby malt mill on the River Turret¹³.

In the next operation the ground malt was macerated with warm water for several hours in a mash tun. Mashing had traditionally been performed by men, with wooden instruments, but by the 1820's the process was undergoing mechanisation:

"A very strong iron screw, of the same height as the mash-tun, is fixed in the centre of this vessel, from which proceed two great arms or radii, also of iron, which (are) beset with vertical teeth, a few inches asunder, in the manner of a double comb; ...the iron arms, which at first rest on the false bottom, are made to revolve

slowly on the central screw, in consequence of which, in proportion as they revolve, they also ascend through the contents of the tun to the surface; then, inverting the circular motion, they descend again in the course of a few revolutions, to the bottom".¹⁴

This process may have been mechanised at the Keltybridge brewery, Fife, where, in 1775 "the work of the brewery, and the grinding of the malt, which is done on a steel mill", was "all effected by a rivulet" which ran past the brewery¹⁵. In the absence of further evidence, it can only be assumed that other breweries mechanised the mashing process. In the larger urban breweries, mashing and the pumping of "wort" were almost certainly being performed by steam or water power by the 1820's.

The Industrialisation of Distilling

Information on distilling is a little more readily available. Compared to brewing, whisky distilling was a relative newcomer to Scotland, originating, by different accounts, from Ireland or the Scottish Highlands. Throughout the period small-scale distilling by individuals, whether legally or illegally, continued to be practised in Scotland, particularly in the Highlands. Even in that area, however, the increase in demand for whisky in both England and Scotland was sufficient to stimulate factory production once malt taxes reached a low enough level. Similarities in the processes involved meant that the same mechanical techniques were applied to distilling as to brewing. Grange Distillery, Burntisland, built as a brewery in 1767, had its own water-powered threshing mill¹⁶, as had Kilbagie Distillery, Clackmannan¹⁷. Most capitalist distilleries were equipped with water-powered malt rollers,

while those without adequate water supplies often used steam power for pumping liquids: James Haig and Company's distillery at Canonmills had a steam engine by 1787¹⁸ and Kennetpans Distillery, Clackmannan, was one of Boulton & Watt's first Scottish customers¹⁹. Where water power was adequate it was applied to these and other processes: the ill fated Beaully Distillery used water power to stir the mash tuns and to pump water, wash and wort²⁰. One particularly well endowed distillery, built near Bridge of Don in 1794, had the use of a thirty-eight foot waterfall and was designed to manufacture 12,000 quarters of corn per annum²¹.

The Role of the Excise

Levels of whisky production were strongly influenced by legislative measures. The Wash Act of 1784 effectively divided Scotland into Lowland and Highland districts, which were taxed on the basis of production and capacity respectively. The commercial distilleries of Lowland Scotland had already been forced, by competition from illicit Highland stills, to seek markets outside Scotland; the Wash Act only aggravated their position. Even worse was to come. In 1786 the Wash Act was replaced by the Scottish Distillery Act, which raised the level of excise on Scottish spirits exported to England, so as to equalise the price of English and Scottish products. Prior to that time major distilleries such as Kennetpans and Kilbagie, had depended entirely on the London market²², but with the passing of the Wash Act and then the Scottish Distillery Act, they lost their advantageous position. Further legislation, in 1788, limited the size of the still and put a premium on rapid distillation. By 1799 fast stills had come into general use in Lowland

Scotland, as a result of which the basis of the duty was changed to one of 4s 10½d per gallon of spirit made for consumption at home. During the first year of the new duty (1801) a third of Scotland's eighty-seven licenced distillers gave up business and revenue from the tax dropped from £1,620,388 to £775,750. In 1802 the duty was lowered to 3s 10½d, in response to which the number of distillers rose to eighty-eight in the following year and revenue to £2,022,409. In 1804 the excise was once again raised and the number of distillers declined once more. Because of the wartime shortages distilling from grain was prohibited from June 1808 with serious repercussions in agriculture²³. Spirit duty reached a peak of 9s 4½d in 1815, but fell to 6s 2d in 1817 and 2s 4¾d in 1823.

The Decline of Illicit Distilling

Those distillers who had survived the difficult war years were further encouraged by the Distillery Act of 1824, which marked the beginning of the end for the illicit distillers and the beginning of a boom in distillery building. Glenlivet Distillery, founded in 1824, was one of several built on a formerly illicit site; such was the local opposition to the suppression of illegal stills that for some time the owner carried firearms for his own protection²⁴. The following year smugglers went so far as to burn down the Banks o' Dee Distillery in Aberdeenshire²⁵. About sixty years later, Alfred Barnard visited some one hundred and twenty-nine distilleries in Scotland; of these, at least forty dated from 1820's - thirteen in 1824, eight in 1825 and five in 1826²⁶. The rise of legal distilleries is reflected in the increase in the gallonage on which duty was paid, from 2,225,124

gallons in 1822 to 5,981,549 gallons in 1825²⁷. Not that this necessarily represented an absolute increase in total output: up to the end of the 18th century, it was claimed, duty was paid on only 1/40th of Scottish production and not until 1821 were any concerted attempts made to stamp out illicit distillation²⁸.

While it seems certain that some distilleries, such as those around Campbeltown, used steam power to crush their malt, stir their mash tuns and drive their pumps, the rural situation of the majority would suggest that water power was the general rule. This assumption is supported by the fact that so many distilleries were still using water power in the 1880's, well into the "Age of Steam".

Conclusion

By 1830 whisky distilling had come to occupy an important position in the economy of Scotland, particularly in the Northern and Eastern Highlands. Although the products of Scottish breweries found ready sale in London and elsewhere, the extent of these sales was hardly comparable with that of whisky.

Within Scotland it had succeeded in ousting ale as the national drink. Furthermore, through malt taxes and spirit duties the government were able to benefit from the industry: before 1788, Kilbagie and Kennetpans distilleries had between them paid more excise than was raised by the land tax in Scotland and at one time Kilbagie alone paid £500,000 Sterling in duty per annum²⁹. Were it not for the availability of water power, it is doubtful whether the rural sector of the distilling industry could have been established on the scale it was.

Nowhere is this more evident than on Speyside, where access to water both for making whisky and driving machinery was good, but access to coal for steam engines very poor.

REFERENCESCHAPTER THIRTEEN

- 1 : Clow, A. & Clow, N.L. "The Chemical Revolution"
London 1952 573
- 2 : Singer, Dr. "General View of the Agriculture of
Dumfriesshire" Edinburgh 1812
- 3 : Graham, P. "General View of the Agriculture of
Stirlingshire" Edinburgh 1812 349
- 4 : For a full account of the landowner's role in the
creation of planned villages see Smout, T.C. "The
Landowner and the Planned Village in Scotland" in
Mitchison, R. & Philipson, M.T(Ed.) "Scotland in
the Age of Improvement" Edinburgh 1970
- 5 : Smout, op.cit., 94
- 6 : Donnachie, I.L. "Industrial Archaeology of Galloway"
Newton Abbot, 1971 55
- 7 : Whitehead, W.Y. "History of Ormiston" Haddington, 1937 41
- 8 : Butt, J. "Industrial Archaeology of Scotland" Newton
Abbot, 1967 230
- 9 : Ibid., 233 (Banff)
Wight, A. "Present State of Husbandry in Scotland"
4 vols Edinburgh 1778-82
IV 385 (Grantown)
Butt, op.cit., 239 (Thurso)
- 10 : SRO GD10/1266
Kennedy, W. "Annals of Aberdeen" 2 vols. London 1818 I 388
SRO RHP 814
- 11 : PP 1831-2 XLII (Annan)
OSA VIII 592 Alloa, Clackmannanshire
OSA XII 170 St Vigean, Angus

- 12 : Caledonian Mercury 29th July 1775
OSA XVIII 440 Bo'ness, West Lothian
- 13 : OSA IX 583 Crieff, Perthshire
Porteous, A. "History of Crieff" Edinburgh 1912 169
- 14 : Accum, F. "Treatise on the Art of Brewing" London 1820 47
- 15 : Caledonian Mercury 28th August 1775
- 16 : SRO RHP252
Morison, W.M. "Dictionary of Decisions of the Court
of Session" 36 vols. Edinburgh 1820 III 1991
- 17 : OSA XIV 626 Clackmannan, Clackmannanshire
- 18 : NLS Acc. 5111/27
- 19 : OSA XIV 623 Clackmannan, Clackmannanshire
- 20 : SRO CS96/209 Letter Book of Beaully Distillery Company
- 21 : Kennedy, op.cit., I 423
OSA XIX 222 Aberdeen, Aberdeenshire
- 22 : OSA XIV 623-4 Clackmannan, Clackmannanshire
- 23 : Clow & Clow, op.cit., 554-66
- 24 : Barnard, A. "The Whisky Distilleries of the United
Kingdom" (1887) Newton Abbot, 1969 219
- 25 : Clow & Clow, op.cit., 567
- 26 : Barnard, op.cit.
- 27 : Ordnance Gazetteer VI 83
- 28 : Clow & Clow, op.cit., 567
- 29 : Graham, P. "General View of the Agriculture of Kinross-
shire & Clackmannanshire" Edinburgh 1814 360
OSA XIV 623 Clackmannan, Clackmannanshire

THE MILL ON THE FARM

One of the principal elements in agricultural Improvement was the introduction of more efficient, less labour intensive techniques. Improved ploughs, notably that of Small, found favour in that they could be worked by one man and two horses, instead of the team of six, eight or ten oxen or horses, and four men, required to coax along the old Scots plough¹. The preparation of grain for milling or for animal feedstuffs was another area in which substantial labour savings could be made: both winnowing and threshing employed centuries old techniques which were both inefficient and labour intensive. "The grain, as needed, was "cast in" to the barn, "thrashed" with a flail, "cleaned" with a series of riddles, and what aid a current of air passing between two doors could afford; thence it was removed to the kiln to be dried"². A winnowing machine had already been introduced to Scotland³; between 1730 and 1830 machines, often water-powered, were developed to perform a variety of farming tasks such as turnip slicing, straw cutting, butter churning and whin crushing. However, by far the most important and most widely applied innovation was the threshing machine.

"A Capital Improvement in Husbandry"⁴

The problem of devising an effective threshing machine was one which occupied millwrights and other interested parties for much of the 18th century. The earliest machine which has been traced was that invented and patented by Michael Menzies, advocate. Menzies' machine, using the same principle as the flail, was installed to work by water power at several locations, and attracted the attention of the Society of

Improvers who sent a delegation to inspect two machines, one at Roseburn (Edinburgh) driven by a large water wheel with "trindles" (gearing) and another at an undisclosed locality with a wheel of only three feet diameter. The mill at Roseburn succeeded in cleaning grain from straw already threshed by hand and both mills met with the delegation's approval:

"...it is our humble opinion that the machine would be of great use to farmers, both in threshing the grain cleaner from the straw and in saving a great deal of labour; for one man would be sufficient to manage a machine which would do the work of six"⁵.

Despite this auspicious start, it was later discovered that, to thresh the grain effectively, the flails had to work at so high a velocity that they soon broke. Before long the Menzies machine had fallen into disuse⁶. A similar machine erected by Gordon of Premnay at Licklyhead (Aberdeenshire) suffered the same fate⁷.

The next stage marks the beginning of a long line of machines which, while ultimately achieving relatively good results, was never acknowledged as perfected. In 1748 or 1758⁸ Michael Stirling, farmer at Craighead* invented a threshing mill which utilised a scutching principle, already employed in lint mills⁹. Stirling's machine, driven by a vertical water wheel¹⁰ had four horizontal scutching arms and was sufficiently good for several to be set up in Scotland and in England. According to the Statistical Account, the design was improved by a Mr. Meikle (probably George) of Alloa who, by adding another gear-wheel, was able to put the threshing boards onto a horizontal axis and thereby permit the addition of

* Dunblane, Perthshire

bruising rollers¹¹. In view of later developments, the intervention of Meikle is of great significance. In his General Report for Angus, Headrick describes in considerable detail a threshing mill, of a type first used near Dunblane, which had been installed at Howmuir near Forfar at a cost of £20. A Mr. Stirling is named in connection with the mill and, indeed, it resembles Stirling's original design in all but one respect: at Howmuir a horizontal water wheel was used, with blades set at an angle of 45° to meet water from a wooden flume at right angles¹². The Farmers' Magazine described, in 1807, a threshing machine costing only £10 "lately invented in Perthshire"; while closely resembling the Howmuir mill, it had the additional refinement of curved upper edges to blades which prevented water from splashing over¹³. A later edition mentions a machine invented by a Mr. Monteith at Shirrasmuir (Sheriffmuir) near Dunblane and improved by William Keir at Milnholm, Dumfriesshire. Keir's mill had cost £36 9s 1d to erect; five more had been built at a cost of £18 - £37 and sixth was under construction at Eastfield, near Bowden, Roxburghshire¹⁴. Despite criticisms made of them, machines using a scutching principle, apparently originating in the Dunblane area, seem to have achieved quite a wide currency. According to Sinclair, Stirling-type mills were still being used in some parts of Scotland as late as 1814, worked by water power or by oxen¹⁵. Perthshire in particular remained faithful to this type of machine and when Sinclair established a fund to reward Meikle for inventing the threshing machine, the Strathearn Agricultural Society refused to subscribe, on the grounds that it was Michael Stirling, not Andrew Meikle, who

had invented it¹⁶.

Whatever the sentiments may have been in Strathearn, it is generally Andrew Meikle who is credited with perfecting the threshing machine. "Perfecting" is probably more accurate a term than "inventing" for, in addition to the machines already mentioned, several others preceded that patented by Meikle in 1788 and may well have influenced it.

In 1772 or thereabouts, a Mr. Ilderton, near Alnwick and a Mr. Smart at Wark*, both in Northumberland, built machines which, instead of scutching the grain, rubbed it off. Sheaves of corn passed between an indented rotating drum, of about six feet diameter, and a number of similarly indented rollers, pressed against the drum by means of springs. The machines were far from perfect, performing very little work in a given time and bruising the grain so badly that its market value was seriously impaired¹⁷. A similar machine erected by a Mr. Oxley at Flodden (also in Northumberland) achieved a slightly better result¹⁸.

While touring Northumberland, Sir Francis Kinloch of Gilmerton (East Lothian) came across the threshing machines built by Smart and Ilderton¹⁹ and was sufficiently impressed to have models made for his own use. Back in East Lothian Kinloch modified the design by enclosing the drum in a fluted cover and fixing four sprung pieces of fluted wood onto the circumference of the outer cylinder. In 1784 the model thus modified was sent to Andrew Meikle for tests to be carried out at Houston Mill, near East Linton²⁰.

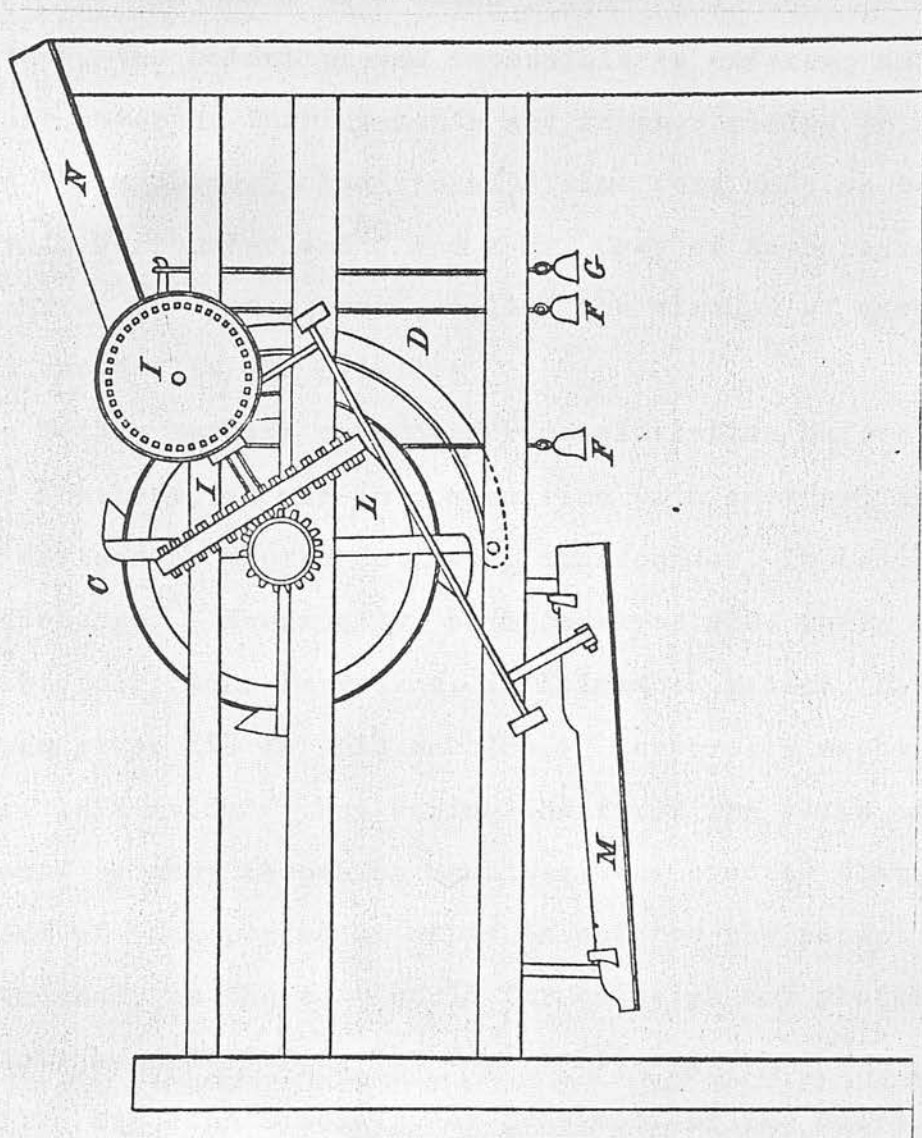
Before proceeding any further, it is necessary to go back a few years. Apparently Meikle had already been working on threshing machines and by 1778 had installed a prototype at *Apparently the village of that name on the River Tweed rather than that on the North Tyne.

Knowes Mill (East Lothian). At this stage, he was still trying to improve on the flail principle used by Menzies: five flails, attached to a beam which was moved by a crank, threshed corn on two platforms, one on either side of the beam. In trials on 14th February 1778 the machine performed well, threshing more grain than could be done by flail; Andrew Wight, the authority on farming, was impressed by this performance as were a number of East Lothian gentlemen who immediately brought it to the notice of the Board of Trustees for Manufactures. Some four months later, Meikle himself submitted plans of "Machinery for threshing corn and scutching flax"²¹. A similar machine, apparently more efficient, had been developed by John Thomson at Keith Mill (East Lothian); Wight described this machine as "simple", "easily moved" and deserving to be made public. News of Thomson's mill had also reached the Board of Trustees, who asked that its performance be compared with that installed at Knowes Mill before Meikle was granted a premium for the latter²². Unfortunately, no record of their relative merits exists: Thomson seems to have returned to obscurity, while the next that is heard of Meikle is in 1784 when he received Kinloch's model for testing. No. 1043) was taken out for a fourteen-year period. If we are to believe George Rennie, writing some twenty-seven years later, Meikle found little use for the Kinloch machine, and suffered it to remain in his shop, as a piece of useless lumber"²³. When the machine was finally put to the test, it was torn to pieces in a matter of minutes; a like fate befell a full sized machine which Sir Francis installed at Athelstaneford Mains²⁴. Whatever the weaknesses of Kinloch's machine may have been however, it must have given Meikle food

for thought, for in the following year (1785) he started work on a threshing machine based, like Kinloch's, on a revolving drum, but with short scutchers, working within a close-fitting breast-work, rather than fluted surfaces²⁵. In 1786 he communicated his ideas to his second son, George, millwright of Alloa who, it may be recalled, made improvements to Stirling-type machines. George was much employed by James Stein of Kilbagie who, in addition to a distillery, ran an extensive farm. Unable to find enough barn-men to thresh straw for cattle litter, he engaged George to build a threshing mill. The mill which George built was identical to that devised by his father with the exception of two fluted rollers which were added to it²⁶. In agreeing to have the mill built, Stein offered to provide materials, but declined to pay for workmanship unless the mill performed satisfactorily. In the event the machine, driven by water power, "answered so well, in point of expedition and effort, that the proprietor declared he would not take a present of common threshing by flail"²⁷.

In 1787 Andrew Meikle built a second machine driven by horses at Phantassie (East Lothian) and in the following year a patent (No. 1645) was taken out²⁸ for a fourteen-year period (figure 14.1). An advertisement was placed in the "Scots Magazine" in the following terms:

"It is a species of mill, capable of being worked by two horses, or any power of wind or water equivalent to that force. The work performed is twenty-four bushels of barley or oats per hour, wheat and other grain in proportion. The corn is not only separated completely from the straw, but made ready for the market



by being riddled and cleaned from chaff. No attendance is needed but for that of three men, women and boys ... Gentlemen may either erect the machine themselves, upon a plan furnished by the Inventers; or contract with them for the whole at a fixed price"²⁹.

In practice, the patent proved impossible to enforce, and there were numerous infringements and further claims to have invented the machine. Additional claims were made on behalf of Oxley in Northumberland³⁰ and a Mr. Crow of Netherbyres, Berwickshire³¹. Yet others extolled the virtues of machines based on waulkmills and oilmills³².

When the Meikle machine came up for consideration before the Board of Trustees, it was in competition with another, smaller machine devised by George Cotterel, ironfounder, in Leith Walk, Edinburgh³³. Eventually, both received £20, while a third contender, John Fergusson, in Kilmadock parish, Perthshire, was given £15 for his machine. Cotterel's machine was "soon laid aside"³⁴ but during the first ten years of the patent, so many threshing machines were erected that, at the end of that period attempts to enforce the patent were abandoned, as the cost would far outweigh any profits which might be made during the four remaining years³⁵.

Eventually, Sir John Sinclair, as president of the Board of Agriculture, established a fund and managed to raise £1,500 on Andrew Meikle's behalf³⁶.

To give the Meikles their due, the use of feeding rollers and the high speed rotation so crucial to the success of the machine were undoubtedly their own innovation. While the use of a revolving drum might have owed something to Oxley, and the use of scutchers to Stirling, it was the

Meikles who successfully combined the two elements with other ingenious ideas. Above all, there is no doubt that Andrew Meikle, the foremost millwright of his century, was quite capable of inventing such a machine.

The Diffusion of the Threshing Machine

Once perfected, the threshing machine was rapidly taken up. By the late 1790's it had become well established in the Lothians, the Merse, Fife, and east central Scotland; a few examples were beginning to appear in the Borders, Galloway, the north east, Angus and west central Scotland, but as yet none had reached the northern or western Highlands³⁷. By 1810, they had become almost universal in the Lothians and Merse and common in most arable parts of Dumfriesshire, eastern and north-eastern and central Scotland. In Renfrewshire and possibly elsewhere in west central Scotland, they were still fairly uncommon, and although machines had been installed on a few farms in Inverness-shire and Sutherland, none had yet reached Argyll³⁸. The New Statistical Account, comprising entries written in the 1830's and early 1840's gives a fairly detailed impression of the situation at the end of the period under consideration. Outside the northern and western Highlands and Islands, the use of threshing machines was nearing saturation point with the exception of parts of the southern and Grampian Highlands where they were, nevertheless not uncommon³⁹.

At the same time as this spatial diffusion was taking place, a similar process was underway entailing diffusion from farms with larger arable acreages to those of smaller extent. To a considerable degree, this also involved a downward diffusion through the ranks of farming society. Thus, in

East Lothian and the Merse, where large productive arable farms were the rule, the rapid adoption of the threshing mill was only to be expected. In areas of smaller farms, or less intensive arable husbandry, the first initiative generally came from heritors: the first threshing mills to be built in Caithness and Peeblesshire, during the 1790's both fall into this category, the former built by Trail of Hobbister, the latter by Kerr of Kerrfield⁴⁰. The same arrangements continued to be made for small tenants after the larger ones had installed their own machines: this was certainly true of Aberdeenshire (1811)⁴¹ and even in East Lothian, where the threshing machine was very widely applied, the villagers of Ormiston made use of one installed at Ormiston Mill c.1823 to thresh grain from their small plots⁴². In Sutherland they were installed in extensive new steadings on the Duke of Sutherland's estates, along the narrow coastal strips (figure 14.2); in Inverness-shire, by 1808, several heritors had built threshing mills, starting with Davidson of Cantray⁴³. By the late 1830's they had reached a much smaller class of farmers: in Fordoun and Marykirk parishes (Kincardineshire) almost every farm of more than 100 acres had one⁴⁴, in Kilmarnock parish (Ayrshire) the figure was 60 acres⁴⁵, in Udny and Auchterless 50 acres⁴⁶ and in Tarves, Longside and Oyne, (all Aberdeenshire) 30⁴⁷. In Boyndie parish (Banffshire) threshing machines had descended to the class of crofters⁴⁸, in Carstairs to pendiclers⁴⁹ while in Ayton (Berwickshire) every farm had a threshing machine by 1834⁵⁰.

Needless to say, by no means all these threshing machines were water-powered. The commonest were driven by two, three or four horses, but water power was found to be "by far the

cheapest and the best power to be applied to threshing mills. From the equality and gentleness of the motion, the machine will last twice as long as one drawn by horses; and as water mills generally do much more work when in motion, they do not require to be so frequently used. It is calculated that in threshing a crop of any extent, a pair of horses may be saved upon the farm, by the use of a water-mill, which cannot be calculated at less than L100 per annum"⁵¹. Water-powered threshing mills were commonest in those areas where topography and drainage facilitated the construction of dams and where farms had sufficiently large arable acreages to justify installation costs. Although no adequate contemporary source exists, the distribution of water-powered threshing mills on the First Edition Ordnance Survey Maps gives a fair indication of that in 1830. As for the numbers, about 4,500 have been traced from the above source and this too can be taken as an indication of numbers in 1830. In some cases considerable efforts were made to bring water power to a steading: one mill, constructed by James Watt, millwright in Biggar, was connected by means of inclined shafts to a water wheel fifty feet below and one hundred and twenty feet distant from it. A similar example, erected at Crowhill, near Dunbar, cost some £800⁵². In the lowlands of eastern Scotland, from the Merse to Easter Ross, a few wind-powered mills were built. Despite their high cost, they were apparently "becoming very common" in Berwickshire by 1810 while in East Lothian there were seven by the late 1830's⁵³. Steam threshing mills were known of as early as 1811⁵⁴, but a combination of a shortage of skilled operators, anxieties about the use of "fire engines" on farms, poor access

to coal and high installation costs restricted them to those areas where large arable farms were unable to make effective use of water power but could readily obtain coal. In East Lothian, where they seem to have taken on most strongly, there were about eighty farms with steam threshing mills by the late 1830's⁵⁵.

From contemporary evidence, water and wind power emerge as the cheapest forms of threshing mill to operate but, according to figures for Midlothian in 1811 water-powered mills at £150-£160 each were considerably cheaper to install than wind-powered ones at £450-£470⁵⁶.

Conclusion

For those men, variously designated lotmen, barnmen and taskers⁵⁷, who threshed by the flail, work was slow and tedious and yielded a remuneration of only 1/25th of the grain threshed, or a cash payment of 1s 3d per boll⁵⁸.

With such a gruelling occupation and with payment on a piecework basis, it is hardly surprising that the system was abused. From contemporary writings it is apparent that farmers and landowners despised and distrusted the tasker; this, with increased agricultural output and more lucrative employment opportunities elsewhere intensified the demand for a mechanical substitute. As one might expect, the threshing mill, once perfected, spread rapidly through the Lowland districts of Scotland and was hailed as "the most useful and profitable instrument belonging to a farm" or even as "the greatest improvement that has been introduced... during the present age"⁵⁹. The "Code of Agriculture" lists its benefits as follows:

"1. From the superiority of this mode, one-20th part

more corn is gained from the same quantity of straw than by the old fashioned method.

2. The work is done more expeditiously.

3. Pilfering is avoided.

4. The grain is less subject to injury.

5. Seedcorn can be procured without difficulty from the new crops for those to be sown.

6. The market may be supplied with grain more quickly in times of scarcity.

7. The straw, softened by the mill, is more useful for feeding cattle.

8. If a stack of corn be heated, it may be threshed in a day, and the grain, if kiln dried, will be preserved and rendered fit for use.

9. The threshing mill lessens the injury from smutty grain, the balls of smut not being broken, as when beaten by the flail.

10. By the same machine, the grain may be separated from the chaff and small seeds, as well as from the straw."⁶⁰

Although the majority of threshing mills were powered by horses, and others by wind or steam power, water power, where available, was considered to be the best option. Such was their success that by 1830 there were probably more water-powered threshing mills in Scotland than any other type of water mill, and once the initial outlay had been made, the available power could be harnessed to drive additional farm machinery.

Fanners

Fanners or winnowers were first introduced to Scotland by Andrew Meikle's father, James in the 1700/s. In its early form the machine consisted simply of a wheel, fitted with four fan blades of wood or iron, which revolved at a great speed within a drum. The strong draught thus produced issued forth from an opening in one side of the drum; when passed slowly through this draught the chaff blew to one side, while the grain fell straight down⁶¹. Although James Meikle was familiar with water-milling, it seems probable that this early machine was hand driven. No more is heard of fanners until 1737 when Andrew Rodger, a farmer from the Hawick area built a machine based on the Dutch design, and succeeded in selling fanners on both sides of the Border. By the 1790/s his descendants were selling about sixty per annum, at two to three guineas each⁶².

In the meantime, fanners had come into general use in the arable districts of Scotland: machines had been installed in almost every mill, some of them possibly driven by water power. Many more fanners were to be found in farm steadings. In 1768 Andrew Meikle had taken out a patent on a machine which combined a riddle and fanners for dressing and cleaning corn⁶³, and although they were not included in the prototype of Meikle's successful threshing machine, fanners, rakes and shakers were soon added; when it was advertised in 1789 the machine was said to be capable of preparing grain for market by riddling and winnowing the threshed grain, almost certainly with Meikle's own patent machine⁶⁴.

During the next twenty-five years, fanners and riddlers came

to be very common features of threshing mills, particularly where there was powerful water-powered machinery⁶⁵. Initially winnowing still had to be completed by hand⁶⁶ but through improvements in design and the addition of more fanners it would appear that this was no longer necessary by the early 1810's⁶⁷; the threshing machine installed at Swellhead Farm, Maryculter (Kincardineshire) in 1836 had no less than three sets of fanners⁶⁸. In some cases a chain and bucket system was fitted, whereby grain could be returned for further winnowing⁶⁹.

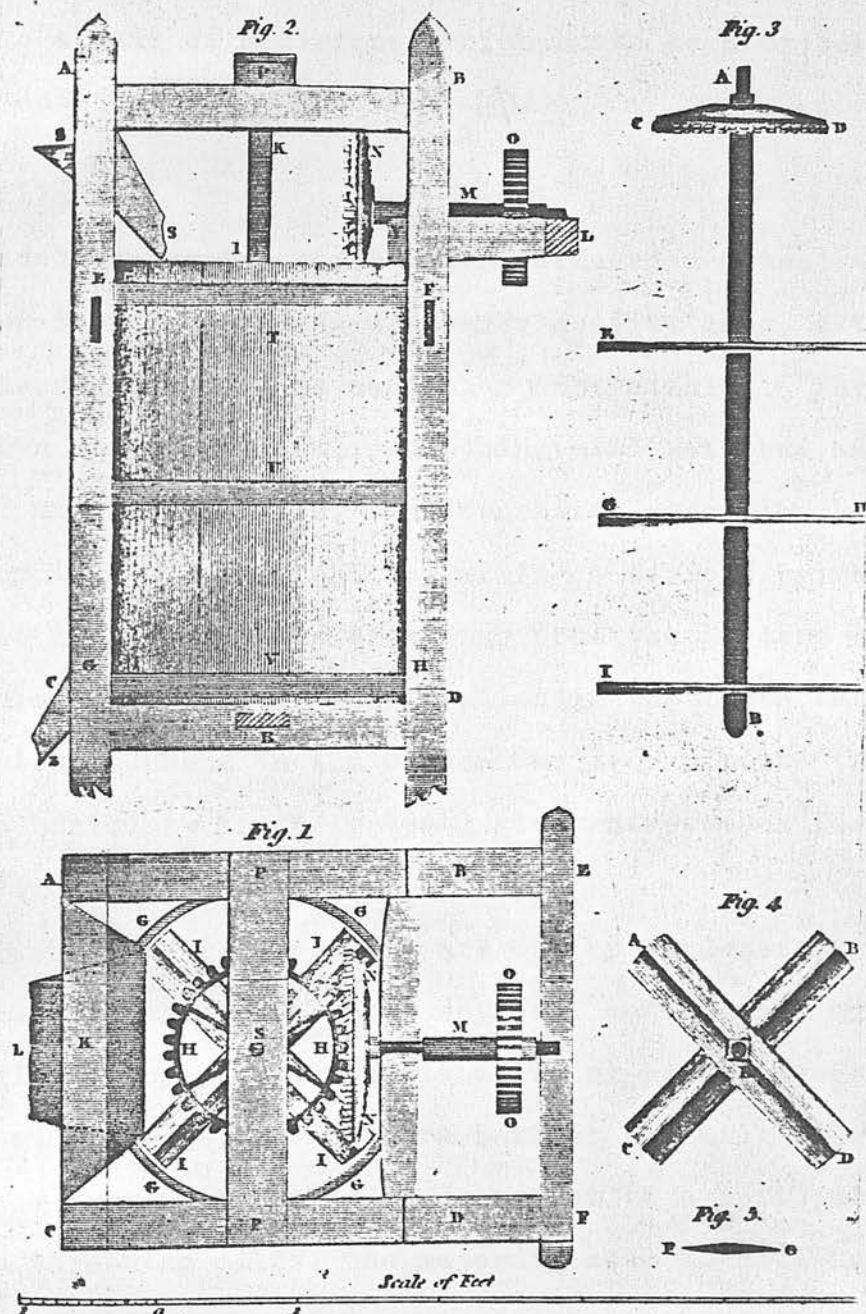
Hummelling, Bruising and Chopping

Barley proved particularly difficult to dress, in that most threshing machines failed to detach the awns* from the grain, a process known as hummelling. Sometimes the chain and bucket system, already mentioned, might be used to return the grain to the threshing machine, but in the absence of this, barley had to be hummelled by hand. In 1810 or thereabouts a Mr. George Mitchell, millwright at Bishop Mill (Moray) designed a machine for hummelling barley, which was attached to several threshing machines including a water-powered mill at Skelbo farm, Sutherland⁷⁰ (figure 14.3). According to Sir John Sinclair, those who had made use of the machine found it "a great improvement" but to this he added a rider that "the merit of this invention is disputed"⁷¹.

Sinclair's "General Report" gives details of two types of machine for bruising grain for horsefeed, both of which could bruise five to six bolls of oats, wheat or barley per hour⁷². Thomson's 1778 threshing machine incorporated, inter alia,

* Beards or spikes

MACHINE for DRESSING BARLEY or BEAR



straw cutters and machines of this type were in use in the 1810's, having also found an application among tanners in chopping bark⁷³. The water-powered threshing mill at Mount Annan (Dumfriesshire) incorporated both corn bruisers and straw cutters⁷⁴. In Berwickshire, and probably elsewhere in the south east, some farmers used the threshing mill wheel to drive a pair of millstones which broke corn or beans and ground oats or barley⁷⁵.

Whin Mills

As a widely occurring shrub, whins offered a potential fodder crop for farmers in areas of poorer quality land, although their needle like leaves made them unpalatable. The earliest known example of a whin-crushing mill was that added to a snuff mill at Woodside, Aberdeenshire, some time between 1764 and 1771⁷⁶. Thereafter, mills on various principles were set up over an area extending from the Borders to Inverness-shire, but with a concentration in the north east⁷⁷. An undated document in the Gordon Castle muniments (probably late 18th century or early 19th) gives directions for preparing whins for mills:

"...when the tender crops are cut by gardeners'(sic) scissors, hooks or short scythes, and bruised by flails, mill or engines like waulk mills or heavy stones going round on edge, as a common bark or oil mill to clear them from prickles and reduce them to a soft pulp"⁷⁸.

As with threshing mills, the majority seem to have been powered by animals, although water-powered ones such as that already cited, are known to have existed.

Butter Churns

According to Fenton, barrel and box churns were already replacing plunge churns in most Lowland counties by the 1790's.⁷⁹ The rotary motion by which they were operated was readily adaptable to water and horse power, and from the 1810's onwards there are occasional references to churn mills: Keith (1811) cites an example in Aberdeenshire and the New Statistical Account (1837) mentions one in Ceres parish, Fife⁸⁰. However, it was in the west, and particularly in Renfrewshire that water power was most widely applied to churning. A "churning mill" appears on Ainslie's map of Renfrewshire (1796)⁸¹ and the writer of the General View for that county (1812) speaks of them as a "most material improvement in machinery", before going on to describe their operation:

"The churn, in this case, is in the form of a hogshead, and was fixed in a horizontal position. The frame for breaking the milk is moved with a moderate velocity, on an axis passing through the centre of the churn, while the churn itself remains at rest; and to prevent the escape of the milk, apperture (sic) for admitting the axis is small and closely fitted. The whole apparatus is simple ...the expense is small and the advantage in saving labour great"⁸².

At Neilstonside Farm, a churn mill in the steading was linked to a water wheel on Lovern Water by means of underground shafting, in a manner similar to the threshing mills at Biggar and Crowhill⁸³. By the late 1830's demand was high enough to justify specialisation by millwrights; thus Hugh Smith at Broomlands, Paisley, appears in Pigot's 1837 directory as "manufacturer of threshing mills and churning mills"⁸⁴.

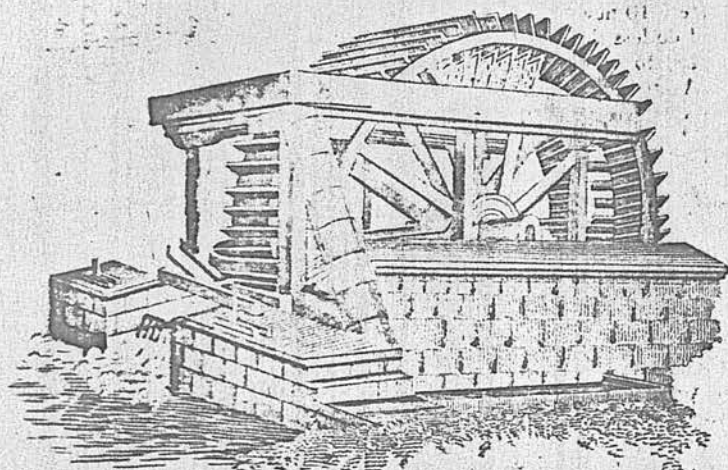
The Blairdrummond Wheel

Before leaving the subject of water power in agriculture, something should be said of an unusual, if not unique, application of water power which, like so many other elements in this Chapter, involved the Meikle family.

Blairdrummond Moss formed part of the peat-covered Forth Carselands above Stirling. In 1766, Lord Kames took on the Blairdrummond estate and by demolishing a corn mill was able to use water from its lade to carry off peats cleared from the fertile underlying Carse clays. Two methods were considered, contract labour or colonisation; having settled for the latter, thirteen tenants, established between 1767 and 1774, succeeded in clearing the lower part of the moss. The upper part where peat deposits were much thicker presented greater problems, but by digging additional channels a further twenty-nine tenants, settled between 1775 and 1782 on lots of eight acres each, were able to make further progress. When, in 1783, Mr. Drummond took over the estate, one thousand acres of the High Moss remained unclaimed, but by digging a further channel across the moss he was able to attract another fifty-five tenants to take on four hundred and forty acres of the moss between 1783 and 1785. However, to remove the remainder of the moss required considerable expense. Several engineers were employed to carry out surveys and make plans for a water supply from the nearby River Teith. A Mr. Whitworth, superintendent of the London water-works prepared plans of a pumping machine, but was soon "upstaged" by George Meikle who presented a model of an "exceedingly simple" machine which he and his father (Andrew Meikle) had designed. Whitworth, recognising the superiority of the

machine, recommended its use in preference to his own, and in the spring of 1787 a contract was signed with George Meikle. By the end of October 1787 the wheel, with its accompanying water-works had been completed at a cost in excess of £1,000. Illustrated in figure 14.4, it shows great ingenuity in its design. The "driving" water was admitted laterally to a double circle of buckets on the inside of the wheel, lifted to the top of the wheel and dropped into a trough which fed a canal. By placing the arms of the water wheel close together between the two circles of buckets, the Meikles were able to construct a close-fitting trough which caught most of the water lifted by the buckets. According to contemporary sources the wheel was twenty-eight feet in diameter, ten feet wide and made four revolutions per minute⁸⁵. The Meikle's "Great Wheel" apparently functioned perfectly and appears with its water courses on a plan of the partially cleared moss (figure 14.5). The last part of the moss was cleared in 1839⁸⁶.

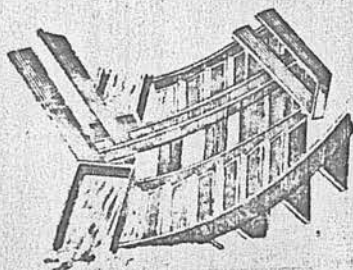
MOSS WATER WHEEL
used at Blair Drummond



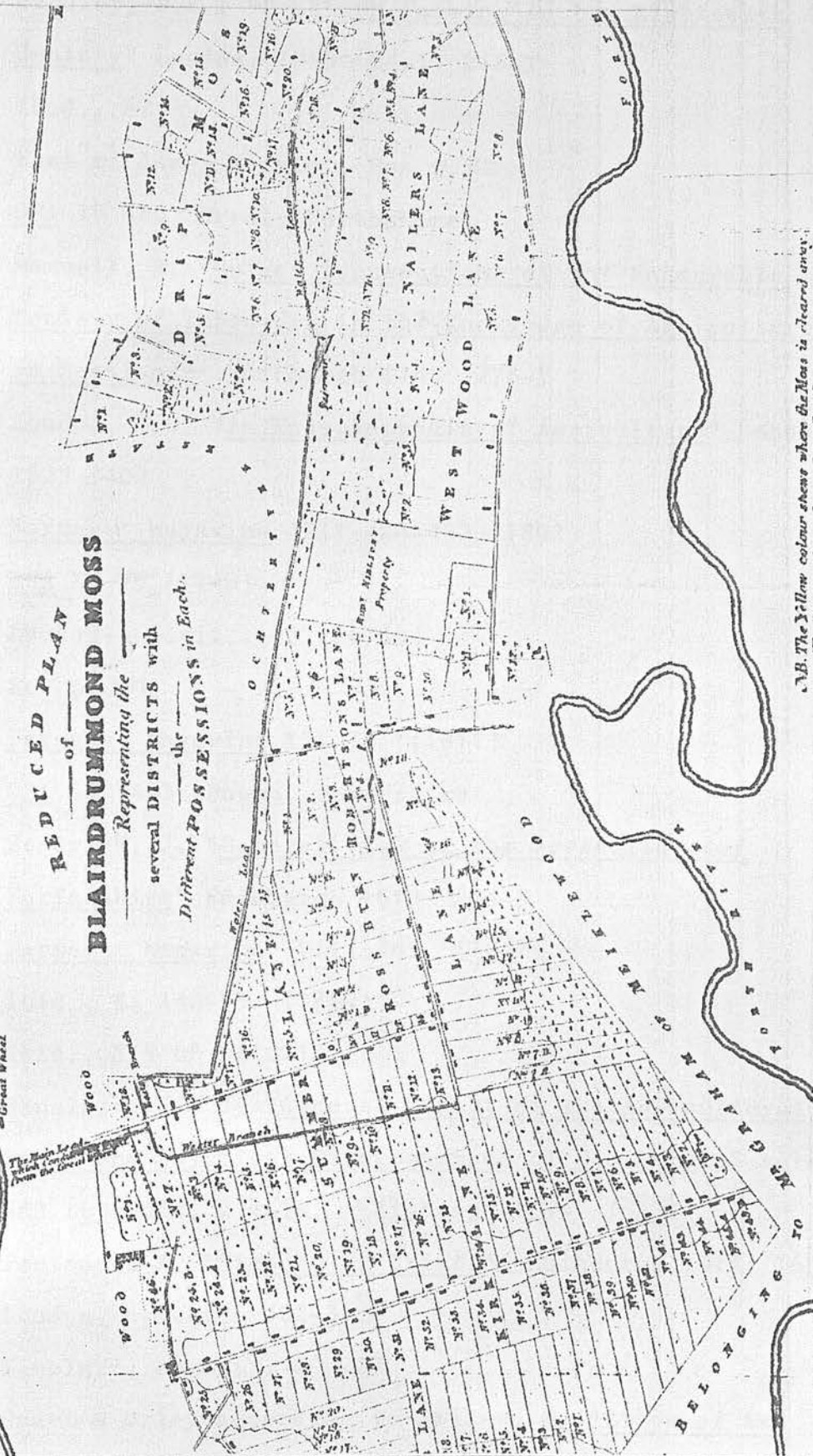
CISTERN
as Seen from above



*manner in which the water is filled
 from the trough into the Buckets*



REDUCED PLAN
of
BLAIRDRUMMOND MOSS
Representing the
several DISTRICTS with
the
Different POSSESSIONS in Each.



N.B. The Yellow colour shows where the Moss is cleared away.

- 1 : Handley, J.E., "Scottish Farming in the Eighteenth Century" London, 1953 64-5, 216-7
- 2 : Ibid., 67
- 3 : That of James Meikle. See p. 42
- 4 : OSA IV 480 Errol, Perthshire
- 5 : Maxwell, R. "Select Transactions of the Honourable Society of Improvers in the Knowledge of Agriculture in Scotland" Edinburgh 1743 276-7
- 6 : Loudon, J.C. "An Encyclopaedia of Agriculture" London 1825 402
- 7 : Farmers' Magazine III 424-433 (1802)
- 8 : OSA XX 75 (1748)
Loudon, op.cit., 402 (1758)
- 9 : See p. 301
- 10 : Farmers' Magazine XII 74 (1811)
- 11 : OSA XX 74-5 Doune, Perthshire
- 12 : Headrick, J. "General View of the Agriculture of Forfarshire" Edinburgh 1813 264-5
- 13 : Farmers' Magazine VIII 465 (1807)
- 14 : Ibid., XI 148-53 (1809)
Ibid., XII 68 (1811)
- 15 : Sinclair, Sir J. "General Report of the Agricultural State and Political Circumstances of Scotland" 3 vols and Appendix, 2 vols. Edinburgh 1814 I 227
- 16 : Porteous, A. "History of Crieff" Edinburgh 1912 165
- 17 : Loudon, op.cit., 402-3
- 18 : Sinclair, op.cit., I 227
- 19 : Smart & Oxley according to Smiles, S. "Lives of the Engineers" 5 vols. London 1874 Smeaton & Rennie, 205

- 19 : Sinclair, op.cit., I 228
- 20 : Farmers' Magazine XII 485 (1813)
Loudon, op.cit., 403
- 21 : Wight, A. "Present State of Husbandry in Scotland"
4 vols. Edinburgh, 1778-82 II 490-92
Smiles, op.cit., 205
SRO NG1/1/22 18th February 1778, 24th June, 1778
- 22 : Wight, op.cit., II 248
SRO NG1/1/22 24th June 1778
- 23 : Farmers' Magazine XII 485 (1811)
- 24 : Sinclair, op.cit., I 228
Loudon, op.cit., 403
Farmers' Magazine XII 485 (1811)
- 25 : Farmers' Magazine XII 488 (1811)
Cartwright, J.N. "The Meikle Threshing Mill at Beltonodod"
TELA&FNS XI (1968) 75
- 26 : Farmers' Magazine XII 486 (1811)
Sinclair, op.cit., I 229
- 27 : Scots Magazine LI 211 (1789)
- 28 : Farmers' Magazine XII 486-8 (1811)
Smiles, op.cit., 206
- 29 : Scots Magazine LI 211 (1789)
- 30 : Sinclair, op.cit., I 227-8
- 31 : Kerr, R. "General View of the Agriculture of the
County of Berwick" Loudon 1809 162
- 32 : OSA V 281
OSA XVI 383 Peterculter, Aberdeenshire
- 33 : SRO NG1/1/27 11th March 1789; 19th January, 19th
March 1791
- 34 : Farmers' Magazine XII 487 (1811)

- 35 : Sinclair, op.cit., I 230
- 36 : Handley, J.E. "The Agricultural Revolution in Scotland"
Glasgow 1963 104
- 37 : Information derived from OSA and pre-1800 "General Views"
- 38 : Information derived from post-1800 "General Views"
- 39 : Information derived from NSA
- 40 : OSA XII Olrick, Caithness 158
Findlater, c. "General View of the Agriculture of
Peeblesshire" Edinburgh 1802 25
- 41 : Keith, G.S. "General View of the Agriculture of
Aberdeenshire" Aberdeen, 1811 259
- 42 : NSA II 145. Ormiston, East Lothian
- 43 : Henderson, J. "General View of the Agriculture of
Sutherland" Edinburgh 1812 61, 134
Loch, J. "An Account of Improvements on the Estates
of the Marquis of Stafford" London 1820 Appendix 2
Robertson, J. "General View of the Agriculture of
Inverness-shire" London 1808 105
- 44 : NSA XI 102-3 Fordoun, Kincardineshire; 303 Marykirk,
Kincardineshire
- 45 : NSA V 549 Kilmarnock, Ayrshire
- 46 : NSA XII 137 Udney, Aberdeenshire; 290 Auchterless,
Aberdeenshire
- 47 : Ibid., 639 Oyne, Aberdeenshire; 672 Tarves, Aberdeen-
shire; 866 Longside, Aberdeenshire
- 48 : NSA XIII 243 Boyndie, Banff-shire
- 49 : NSA VI 557 Carstairs, Lanarkshire
- 50 : NSA II 141 Ayton, Berwickshire
- 51 : Sinclair, Sir J. "An Account of the Systems of Hus-
bandry of Scotland" 2 vols. Edinburgh 1814 I 86

- 52 : NSA II 245 Innerwick, East Lothian
East Lothian County Council "East Lothian Water Mills"
Haddington, 1970 27
NSA VI 365 Biggar, Lanarkshire
- 53 : Kerr, op.cit., 161-2 There were four wind-powered
threshing mills within three miles of Kerr's farm
in Ayton parish.
NSA II 374 General Observations, East Lothian
NSA IX 526 Ceres, Fife
Headrick, op.cit., 262-3 "A few" wind-powered threshing
mills
NSA XII 402 Pitsligo, Aberdeenshire
Souter, D. "General View of the Agriculture of the
County of Banff" Edinburgh 1812 126
NSA XIV 465 Tarbert, Ross-shire
- 54 : Trotter, J. "General View of the Agriculture of the
County of Linlithgow" Edinburgh 1811 41-2
- 55 : Sinclair, "Systems" I 80-87
NSA II 374 General Observations, East Lothian
- 56 : Sinclair, "Systems" I 96
- 57 : Fenton, A. "Scottish Country Life" Edinburgh 1976 79
Trotter refers to them simply as "flailmen": Trotter
J. "General View of the Agriculture of the County of
Linlithgow" Edinburgh 1794 19
An "ode to the threshing mill", circulated when the
Meikle machine first appeared, refers to them as
"supple-drivers" (souple- the part of the flail which
strikes the unthreshed grain): Farmers' Magazine XI 59(1810)
- 58 : Sinclair, "Systems" I 90-91
- 59 : Ibid., 95,98

- 60 : Loudon, op.cit., 407
- 61 : Sinclair, "General View" I 230
- 62 : OSA VIII 521 Hawick, Roxburghshire
- 63 : Smiles, op.cit., 203
- 64 : Ibid., 206
Scots Magazine LI 211
- 65 : See, for example, Kerr, op.cit., 164-5; Headrick, op.cit., 267; Keith, op.cit., 219; Singer, Dr. W "General View of the Agriculture of the County of Dumfries" Edinburgh 1812 137; Whyte, A. & Macfarlane, D. "General View of the Agriculture of the County of Dunbartonshire" Glasgow, 1811 75; Graham, P. "General View of the Agriculture of the County of Stirling" Edinburgh 1812 114; Thomson, J. "General View of the Agriculture of the County of Fife" Edinburgh, 1800 131-3
- 66 : Kerr, op.cit., 164-5
- 67 : Sinclair, "Systems" I 78
- 68 : TH&AS XIV 354 (1843)
- 69 : Sinclair, "Systems" I 98 (footnote)
- 70 : Henderson, op.cit., 134
Sinclair, "General Report" I 498
- 71 : Ibid., I 34-5
- 72 : Ibid., I 247-8
- 73 : Ibid., I 248-9
- 74 : Singer, op.cit., 136
- 75 : Kerr, op.cit., 96
- 76 : Morgan, P. "Annals of Woodside & Newhills" Aberdeen 1886 17
SRO RHP814 (1773)

- 77 : Fenton, op.cit., 141
- 78 : SRO GD44/45/12
- 79 : Fenton, op.cit., 152
- 80 : Keith, op.cit., 219
NSA XI 526 Ceres, Fife
- 81 : GR NS522557 Latterly Netherplace Bleachworks
- 82 : Wilson, J. "General View of the Agriculture of the
County of Renfrew" Paisley, 1812 89
- 83 : Taylor, C. "The Levern Delineated" Glasgow 1831 48
- 84 : "Pigot & Co's National Commercial Directory of the
Whole of Scotland and the Isle of Man" London 1837 724
- 85 : OSA XXI 159-168 General Appendix
- 86 : Imperial Gazetteer I: 174

LINT MILLSTechnology

Long before it had received the attention of the Board of Trustees for Manufactures, the preparation of flax, or lint, by hand was widely practised in Scotland.

Robertson (1808) describes the process as follows:

"After it has been duly watered and dried, the sheaves of flax are formed of the thickness of a man's leg and beat with mallets on a smooth stone, to separate the reed from the rind. Then it is separated into handfuls, such as a person can easily grasp; and with a wooden instrument, made into the form of a hedge-bill or large knife, in the right hand, and holding the lint in the left, over the end of a small perpendicular board set firmly in a sole, which is held down by the foot and about three feet high, the lint is scutched or whipped with the wooden instrument, turning one end of the lint after another to the stroke, and turning the inside out, as appears necessary until the rind has been completely separated."¹

During the 17th century, attempts had been made to mechanise the process. In England patents were taken out by Abraham Hill in 1664 and by Charles Moreton and Samuel Weale in 1692². In Northern Ireland a "flax mill" is referred to in 1717 and again in 1719³. The earliest reference to such a mill in Scotland relates to one at Paisley, first let in 1726; that at Drygrange, Berwickshire, seems to date from the same period⁴. However it

was only with the establishment of the Board of Trustees in the late 1720's that satisfactory lint mill machinery was developed.

In 1727 it was reported to the newly-formed Board of Trustees that, in trials, a flax-beating machine designed by one David Donald "performed exceeding well". Donald was asked to make a full-sized version of the machine, so that Mr. Spalden (or Spalding), lint dresser, might inspect it further⁵. The Trustees later ordered four pairs of Donald's rollers and by December 1729 these, fitted to water mills, were said to "bruise the flax exceeding well, especially at Ceres in Fife"⁶. For the Board of Trustees, this marked the beginning of a commitment to the development of a water-powered flax dressing industry, a commitment which was to stand firm for a hundred years.

Besides testing Donald's rollers the Trustees had been looking into other ways of mechanising flax dressing. On 16th April 1728 it was agreed that James Spalding be sent to Holland to collect models of the most efficient Dutch dressing machines and to learn the techniques employed⁷. By July 1729 he had completed his mission, returned to Scotland and fitted up a machine in Edinburgh. First trials in East Lothian, using horse-power, had proved unsuccessful and a further attempt at Bonnington Mills, using water-power showed little more promise. However, Spalding was of the opinion that an experienced millwright could put the machine to rights and to this end the Trustees asked that Andrew Mitchell (?Meikle)

be brought from Perth⁸. Mitchell's estimate of £48 Sterling was accepted and by the following March the work had been completed⁹. This time the mill performed very favourably: the rollers of the machine bruised the flax at four times the speed of hand breaks or mallets and with equal effectiveness, while the scutchers (revolving blades which struck the flax) proved faster than the hand scutch, but just as effective. The mill had cost only £41 8s 2½d¹⁰.

The combination of rollers and scutchers proved very successful and remained the basis of Scottish flax mill design throughout their history, although minor improvements continued to be made. From the outset the Board of Trustees held an explicit faith in the superiority of water-power over hand-dressing despite widespread criticism.

Within a year of the mill's completion Spalding was claiming to have improved the cylinders and other parts of the machine, bringing its cost down to £13 14s and the cost of flax dressing to 18d per stone¹¹. In 1735 he developed a machine incorporating three rollers instead of the customary two¹² and in 1740 he offered to disclose a method whereby flax could be dressed at half the usual cost, but only on condition that he received a reward for work already done and a loan towards the cost of a new mill¹³. In 1747 the Trustees convened a meeting of lint raisers, dressers and manufacturers with an aim to establishing the best method of dressing flax. Rollers were, by common consent, "the safest and most expeditious" method

of breaking flax, although hopes were also held out for two imported machines. Mill scutching was approved, but only in carrying out the first three-quarters of the process; for the remainder a hand scutching method was recommended. A third process, beating or softening, was also identified; according to informed opinion, this was a vital pre-requisite to heckling. Two fining mills had already been imported for this purpose, although plain, ungrooved cylinders were found to be equally suitable¹⁴. (See Appendix I for technical details of a beating mill.) With a view to testing these machines the Trustees engaged James Currie, lint dresser at Redford Bridge, to build an experimental bruising and fining mill at Colinton. Three years later a grant of £275 Sterling had received the Royal Assent and £120 had been forwarded to Currie¹⁵. Nothing is heard of the relative success of the machines and no further reference is made to fining mills until 1779, when a new machine was recommended for fine fabrics¹⁶. James Currie's name occurs again in 1751, this time as the contested inventor of a flax dressing machine reckoned to be "of the utmost importance to the manufacture". To establish the usefulness of this and a rival machine, the Trustees called in Robert and Andrew Meikle, the most prominent millwrights of the age. Andrew Meikle was asked to test Currie's machine at Kevock Mill; no record of the result exists, although a Currie machine was installed at Newhall Mill, Penicuik in 1752¹⁷. Their continued interest in improving and diffusing the technology of flax dressing is evident from their decision soon after

to engage the Meikles on a permanent consultative basis, on account of their ingenuity "in inventing, as as well as improving many different kinds of machinery requisite for the cheapening of labour"¹⁸.

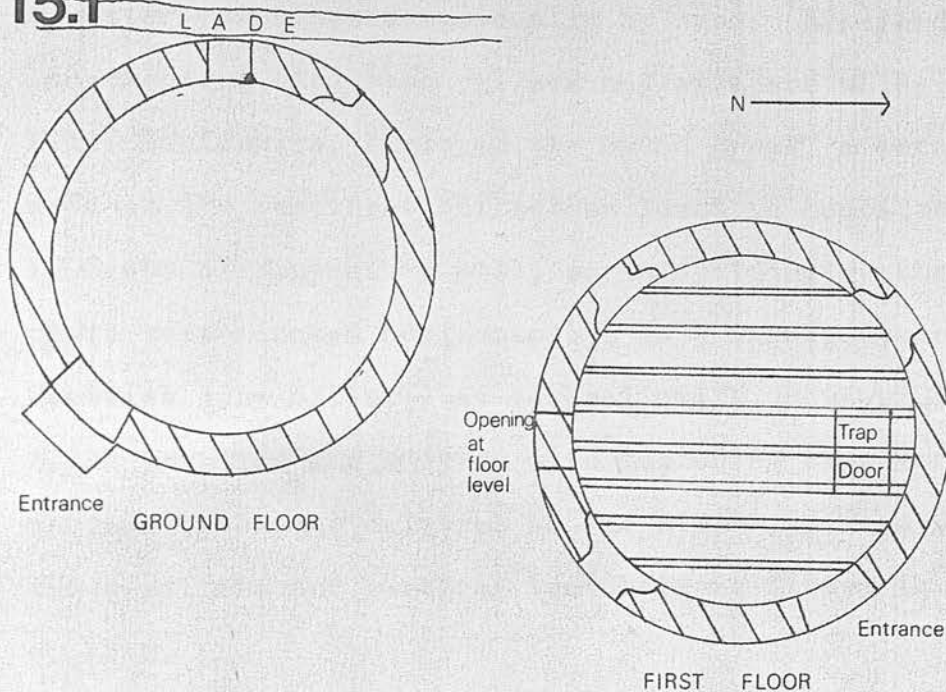
As far as is known, very few illustrations exist of Scottish lint mills but from the few written accounts it is possible to build up a picture of their exterior and interior features. Grant of Monymusk, writing in 1748, describes Hospital Mill, Fife, as being 16 feet by 48 feet with a loft, a thatched roof and a 12 foot shade projecting from one side. A fall of only 3 feet 6 inches drove a wheel 17 feet by 18 inches with a 13 foot axletree¹⁹.

Although most lint mills were of a fairly conventional design a mill built at Invervar, Perthshire, was circular in outline, about 18 feet in diameter with an upper floor for storage (figure 15.1). The builder, Ewan Cameron, had two lint mills at Lawers and was responsible for the construction of eighty or so mills throughout the Highlands. Cameron died in 1817 at the advanced age of 112²⁰.

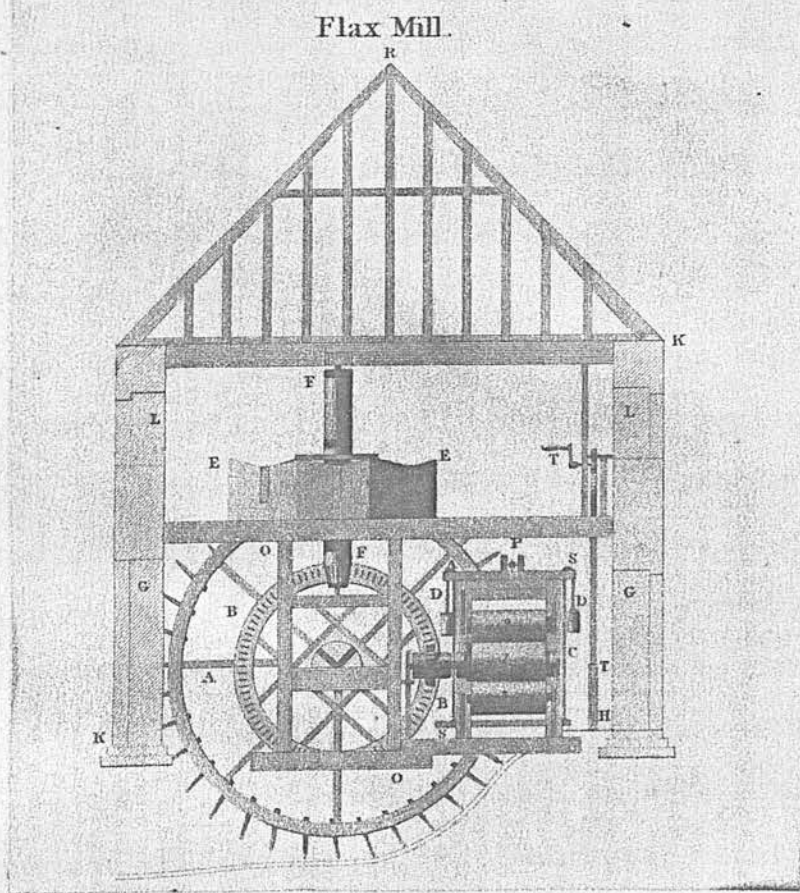
Grant of Monymusk's own mill, completed c. 1750, had separate chambers for bruising, scutching and heckling. Bruising was carried out with three rollers and scutching with an enclosed four-bladed machine with eight apertures through which flax could be introduced²¹.

Despite the Trustees' preference for breaking by rollers, several other methods were still being used in the 1770's the commonest being mallets or stampers, usually moved

15.1



15.2



by water-power but occasionally by hand; Hindford Mill, Lanarkshire, used both rollers and stampers while Cullen Mill, Banffshire, employed the Dutch Break, a method widely used on the Continent but seldom found in Scottish mills. In Grant of Monymusk's mill, as in Spalding's, the scutchers were mounted horizontally, in a manner typical of Scottish lint mills. At several mills, however, the Irish practice was adopted with scutching arms mounted vertically on the axletree of the mill²². Figure 15.2 shows rollers and vertical scutchers as fitted to a mill c. 1810.

Many of the mills recorded in the 1772 survey performed scutching only, while in north Perthshire mills with rollers only were said to be of "great use to the industrious poor"²³. At the opposite end of the spectrum were mills such as that at Gorgie, near Edinburgh, which specialised in beating or softening imported Dutch flax presumably for fine fabrics²⁴.

Although the Trustees commonly blamed human failings for any shortcomings in lint mills they still continued to improve the technology available. The "general complaints and reflections frequently thrown upon lint mills" are dealt with later in this chapter, but they probably encouraged the Trustees to back experiments on new techniques in an attempt to "restore the credit of these mills"²⁵. When, in 1761, a new machine showed promise, the Board of Trustees readily agreed to finance the construction of an experimental mill in Fife and the installation of a second such machine at Angus Macdonald's Elie lint mill

for instructional purposes. Nothing is heard of this actually taking place however; a mill of this type, fitted up at the lint mill of Drum, Banffshire, proved to be inadequate and eventually the machine and its inventor fell into disrepute²⁶.

Reference has already been made to the partial mechanisation favoured in north Perthshire (p. 245). Elsewhere, in even more marginal areas, the Board wished to encourage production and stimulate employment but, because of the small quantities of flax grown, lint mills were out of the question. The need was eventually filled by a foot-driven machine devised by the Board's principal clerk, Robert McPherson, in 1763²⁷. Lord Kaimes, among others, held out high hopes for the new machine:

"It is zealously to be wished, and may reasonably be expected, that flax raising will be greatly promoted by this machine and will creep into every corner."²⁸ Hugh Smith at Carnwath lint mill and Angus Macdonald at Elie, both experienced flax surveyors, also spoke highly of the machine and helped gain for McPherson a £100 reward²⁹. However for all its success, the foot machine was never meant to replace the lint mill and within a few years Smith had incorporated its essential features in a water-powered version fitted up at the Board's expense on the horizontal axle of one of his existing mills³⁰. Similar mills were subsequently built at Lochmaben and Cullen. A further indication of the superiority of the new design is seen in the claim that a mill on the Isle of Bute, hitherto little used, "might be made to do double" if fitted with the new machinery³¹.

On two further occasions Smith was called upon to test other new machines. In 1768 a modified version of McPherson's machine, to a design by Baillie John Reid of Tain, was installed alongside the existing McPherson-type machine. This, the third in one building, was described as being similar to a Dutch scutcher, giving a perpendicular stroke to the flax which was held in an adjustable stock³². Two years later he was granted £40 for a fifth mill, with "yetlin" rollers, to be Built at Wiston, Lanarkshire³³.

At last it seemed that the Board's faith in the lint mill was paying off. In 1773 one was reported to be scutching at a cost below half the hand rate; encouraged by this the Board decided to seek further opinions to "determine the propriety of encouraging or discouraging water mills"³⁴. Although further improvements were made in 1773, 1778, 1782 and 1784 some mills were poorly enough designed for Smith to cite "false principles" in design as one reason for the continuing inefficiency of lint mills³⁵. Apparently most mills had been built with rollers and scutchers driven off the same axle, a practice which greatly reduced the efficiency of a mill. Having considered seeking legal powers the Trustees finally settled for confining financial aid to those mills in which the processes were separately powered³⁶.

In the lack of proper storage facilities the Trustees saw another reason for the less than perfect performance of many mills. As early as 1747 it had been observed that much more wastage occurred in damp weather than in

dry but it was not until 1761 that the Trustees began to offer financial aid for the construction of sheds, while the regular financing of sheds did not start until 1772 (figure 15.3). So overwhelming was the response that by 1797 they were stipulating that all new mills incorporate sheds, or shades, rather than face the possibility of having to make two separate grants³⁷.

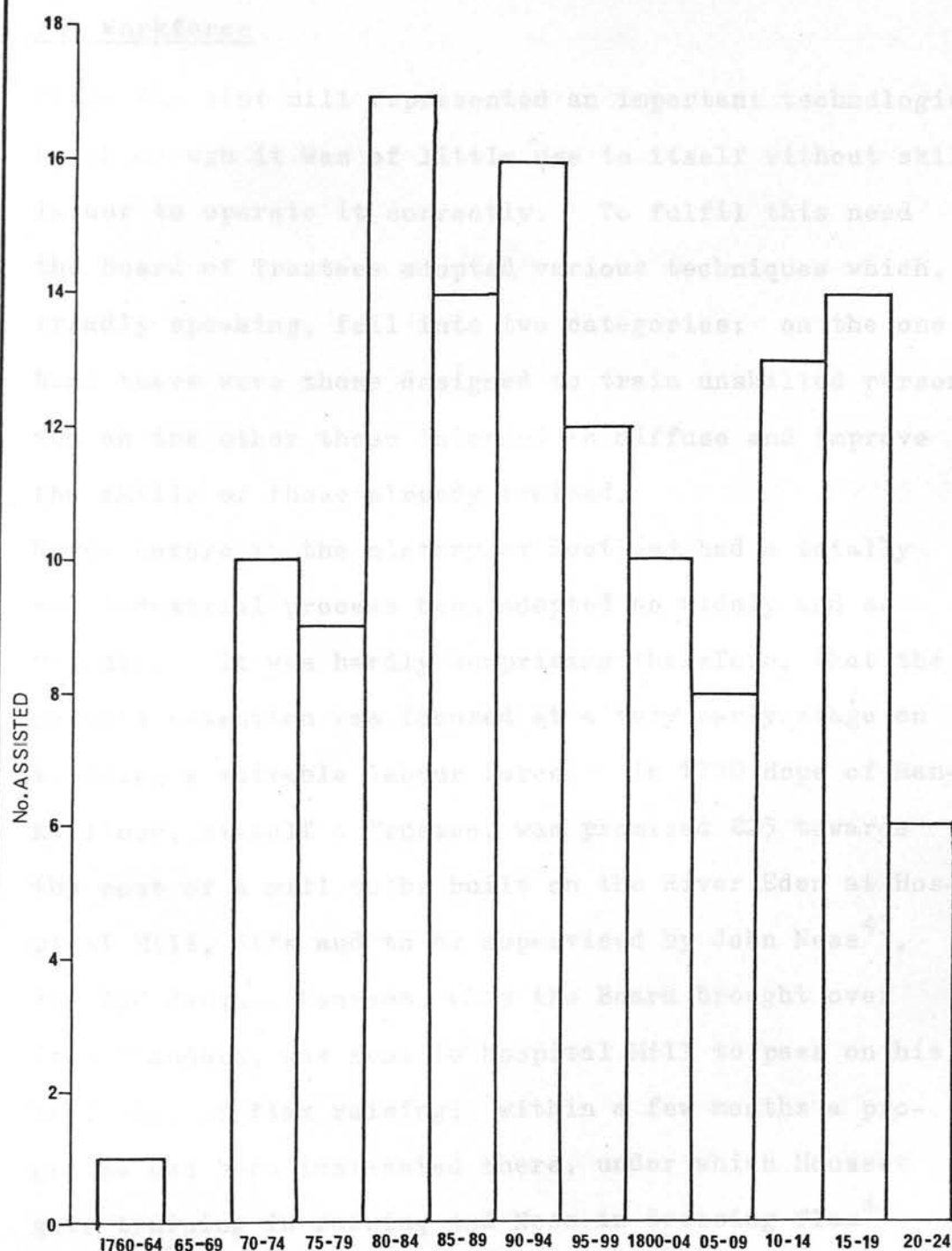
Another way of ensuring that flax to be dressed was in good condition was the provision of drying ovens, a common feature in Holland but one which was hitherto unknown in Scotland. However, when in 1785 the Trustees agreed to give Hugh Smith £12 towards an oven, they were at pains to point out that this was merely an experiment and that no money would be forthcoming for their construction elsewhere. Obviously their commitment to financing mill and shed building was as much as their budget could allow³⁸. As for the "going graith" of the lint mill there were no major improvements during the late 18th century.

In 1790 Hugh Smith was said to be planning a lint mill on a "new and improved plan" but at the time of his death, some four years later, the mill had not been built³⁹.

A supposedly novel lint mill near Panmuir, Angus, while showing some ingenuity in its design, turned out to be very similar to existing mills⁴⁰. A hand machine for dry scutching, the invention of a Mr. Lee, was introduced to Scotland in 1815 but was dismissed by the Board of Trustees: "Mr. Lee's machinery will be of no use in Scotland"⁴¹.

In later years some mills had sprung "wipers" or blades,

15.3



fitted to their scutching arms⁴², but by that time the impetus had long gone out of designing lint mills and had turned instead to larger, more complex machines in more highly capitalised branches of the textile industry.

The Workforce

While the lint mill represented an important technological breakthrough it was of little use in itself without skilled labour to operate it correctly. To fulfil this need the Board of Trustees adopted various techniques which, broadly speaking, fell into two categories: on the one hand there were those designed to train unskilled persons and on the other those intended to diffuse and improve the skills of those already trained.

Never before in the history of Scotland had a totally new industrial process been adopted so widely and so rapidly. It was hardly surprising therefore, that the Board's attention was focused at a very early stage on training a suitable labour force. In 1730 Hope of Rankeillour, himself a Trustee, was promised £25 towards the cost of a mill to be built on the River Eden at Hospital Mill, Fife and to be supervised by John Ness⁴³.

In 1734 Jacques Housset, whom the Board brought over from Flanders, was sent to Hospital Mill to pass on his knowledge of flax raising; within a few months a programme had been instigated there, under which Housset gave training in raising and Ness in dressing flax⁴⁴.

The first person to complete the course was sent to the Glasgow Linen Society's mill at Clayslaps, Glasgow, in

1735 and on Duchal Steps, Renfrewshire, the following year. By August 1737 he had moved yet again, this time to Barochin, also in Renfrewshire, leaving Duchal Steps in the care of a relative⁴⁵. By the end of 1736 some five or six persons, from as far north as Fochabers, had been instructed at Hospital Mill and fourteen more were to be taken on bringing the number up to twenty. Three more were presented in 1738 and by 1740 twenty-four raisers and dressers had been trained and sent out, though not all to established mills. While some "raiser stations" had no mill there were areas such as Angus where the number of mills built, with and without aid, outstripped the number of trained dressers that the Board could supply and on balance it would seem that the training scheme was not keeping pace with mill building⁴⁶. Nevertheless, the Hospital Mill scheme illustrates the determination of the Board to create a pool of skilled labour. The scheme ran until 1753 when it was replaced by apprenticeships⁴⁷. In 1762 John Ness, "now reduced by old age and infirmities", asked the Board for a small pension only to be icily rebuffed: "the board's funds are destined for other purposes than charity"⁴⁸. One of the purposes to which those funds had been destined was the payment of salaries to those lint raisers and dressers whom John Ness had helped to train. Until 1737 the Board helped to finance lint mill construction; from that time onwards this practice was replaced by a £7 10s payment to each of twenty raisers. The "raiser stations" at which they were based were to be inspected

annually by James Spalding who had been appointed "surveyor of the raisers, dressers and hecklers of lint"⁴⁹. In the first year only twelve appointments were made; in 1739 a further nine unpaid dressers were taken on and in 1740 the unpaid raisers, now twelve in number, were brought onto the pay roll, bringing the number of paid raisers to twenty-four. Trained as they were, not all raisers were stationed at lint mills and in an effort to remedy this the Board transferred the £7 10s payment from raiser to mill⁵⁰. The report for 1741 paints a chaotic picture of raisers without mills, mills without raisers and raiser stations with neither raisers nor adequate mills. In that year only eighteen out of twenty-four salaries were paid and in the following year only sixteen out of twenty⁵¹. In 1743 it was reported that two raisers had deserted their posts and that two others had failed to raise enough flax. Three stations had to be given up because of lack of business⁵². The following year saw some improvement with salaries paid to twenty-one of the twenty-four stations and reports for 1745 were generally good, despite the troubled times, only one station being dropped. The following year's results were very mixed, for while one station dressed 1,000 stone of flax, and two others over 500 each, there were at least three raisers still without mills. A good year was 1747, with only four of the twenty-four stations going unpaid and only one being closed down. Six salaries were left unpaid in 1748. By this time the Board were becoming concerned about the number

of mills at which raisers were needed and the number of raisers still without mills:

"those flax raisers who are not possessed of milns should be certified that they will be struck off the establishment unless they shall be provided in milns betwixt now and next Christmas, or if they cannot be provided in these at the places at which they are now stationed, that they must repair to other stations, where there are milns"⁵³.

For 1749 the number of stations was raised to thirty and in the triennial plan from December that year it was proposed that their number be increased further to sixty, although in the event the salaries of the thirty were doubled instead. The Board obviously were very pleased with the progress made by its raisers:

"To these young men and to the milns lately erected is chiefly to be attributed the increase in the quantity of home grown flax,"⁵⁴

In the following four years between twenty-six and twenty-eight raisers received salaries⁵⁵; in 1754 four stations failed to transmit certificates and a further five grew insufficient quantities of flax. The four were struck off the roll and none of the nine received salaries⁵⁶. The raiser system continued to operate in that form until 1758, by which time it was considered that flax cultivation was sufficiently well established in Perth, Forfar and Fife for salaries to be discontinued and instead a 1s per stone premium offered for the greatest quantities raised and dressed⁵⁷. As from 1758 financial support

for flax raisers was restricted to four mills salaried at £10 each and three at £5 each. Salaries for the four mills were discontinued in 1762 and for the remaining three in 1763⁵⁸.

Long before the Board had given up paying lint millers or raisers, another form of sponsorship had been introduced in an effort to extend the cultivation and milling of flax. Such had been the demand for lint raisers that in December 1744 it was decided that experiments should be made with lint boors⁵⁹. In the Low Countries, whence came the idea, lint boors bought up all the local green flax, watered and grassed it and prepared it for the spinner⁶⁰. The duties of the Scottish lint boors were to be broadly similar, with the additional responsibility of building and operating a lint mill and storage houses. The Trustees proposed a premium of £140 per person, £100 of which was to buy up twenty acres of flax per annum for three years and £40 for building the mill. In exchange the lint boor had to undertake to "break, bruise and swingle" at his mill all the flax brought to him, at 1s 2d sterling per stone Amsterdam or 1s 5d per stone Tron⁶¹.

In setting up such an experiment the Trustees had failed to take into account several crucial differences between flax cultivation in the Low Countries and in Scotland. In the Low Countries flax cultivation was centuries old, with large acreages given over to the crop in any one locality. In Scotland, however, as Lord Kames later

pointed out, the manufacture was still in its infancy with only small and widely scattered patches under the crop⁶². It was hardly surprising therefore, that in the first three-year period (1745 - 1747) the Board was unable to find anyone prepared to take on the twenty acre undertakings expected of the first two lint boors⁶³. In the event one post was filled by two men in East Lothian and the other by three men in widely separated parts of Perthshire⁶⁴. By 1747 interest in the idea had increased and six places were offered; of these only five were taken up and these went to East Central Scotland where flax cultivation was already well established⁶⁵. In the following year demand for lint boors mushroomed but of the forty-seven applicants only seven could be found places⁶⁶. The cultivation of flax received stimulus enough to enable thirteen of the fifteen lint boors established by 1749 to fulfil their flax-buying obligations⁶⁷. Early in 1750 the Board still looked favourably on the scheme:

"That the premium £140 has been of great benefite (sic) to the manufacture would appear from the great increase of the quantity of flax raised within the course of the last three years..."⁶⁸.

On the other hand abuses of the scheme were sufficiently common for the Board to insist that lint mills be near completion and twenty acres of flax planted locally before any payment could be made; furthermore their directive to lint boors not to "decoy or entice away" each others' servants suggests a shortage of skilled labour⁶⁹. Before

peated some twenty years later. In December 1771 £500 was set aside as premiums for growing flax. Despite a smaller undertaking of only five or six acres this second attempt seems to have been even more disastrous than the first: in East Lothian the lint boors were unable to obtain the necessary accommodation, in the Merse the lint boor had to struggle to fulfil his commitments while the one in Midlothian neither built housing nor finished off his mill⁷⁵. When it came to distributing the £500 set aside only nine of the seventeen lint boors qualified for premiums and the cost to the Board worked out at about 11s Sterling per stone of flax produced⁷⁶. We must now return to the Board's activities in training labour. In 1753 the Board's training establishment at Hospital Mill was reduced to the status of an ordinary raiser station (p. 245), and to satisfy the continuing need for skilled lint millers it was proposed that apprentices be attached to individual mills where they would be trained at the Board's expense. One of the first to receive apprentices was Angus McDonald's mill at Elie⁷⁷. McDonald was a man held in some esteem by the Trustees and his first apprentice, who finished in 1763, was sent to the Board's own mill on the Isle of Bute⁷⁸. Of the four other apprentices trained at Elie one, Angus McPherson, worked in the Merse on the Board's second lint boor scheme before taking on Grangehaugh Mill, East Lothian, and the post of itinerant flax-raiser⁷⁹. While at Grangehaugh he himself trained at least six apprentices up until the 1790's and at least one more was trained by his successor, John McPherson⁸⁰.

Hugh Smith, another of the Trustees' close colleagues, had instructed five apprentices at Carnwath Mill by 1765 and went on to train at least three more⁸¹. From time to time other mills took apprentices and the practice continued well into the early nineteenth century⁸². In some cases, as at Kilmartin, Argyll, the Trustees used other means to disperse lint milling skills such as paying for the transport and employment of a skilled dresser. These cases were, however, few and far between and the sponsorship was restricted to a short period⁸³. Although the Trustees continued to operate an apprenticeship scheme, the need to do so was lessened by the great mobility of lint millers who could pass on their skills at one mill before moving to another, often newly built, mill. The careers of two millers, Thomas Ness and Patrick Campbell illustrate the point well. Thomas Ness started his training at his father's Hospital Mill in 1741⁸⁴. In 1750 he took a thirty-eight year tack of Lord Deskford's waulk mill at Haugh of Boyne, Banffshire. By March 1751 building work on a lint mill was almost completed and more than twenty acres of flax had been sown. Ness received £140 as a lint boor and became a raiser with salary⁸⁵. In 1758 he was reported to have left Boyne but was apparently still there in 1762, when Lord Deskford agreed to release him to work on a three-year contract for a group of farmers who had built a lint mill at Forgue, Aberdeenshire. By 1763 he was working at Forgue and as an itinerant flax raiser, had a salary of £10 per annum⁸⁶. From the 1772 survey it

appears that Ness had moved again, this time to a lint mill in Banffshire where he had trained the rest of the mill's workers in the art of flax dressing⁸⁷. By 1781 he had made a further move, this time to Glenkindie, Aberdeenshire⁸⁸.

Patrick Campbell was trained as a lint miller at the lint mill of Monzie, Perthshire, where he worked for four years (c. 1749 - 1753). In 1754, or thereabouts, he left to take charge of a lint mill in Angus, returning to Perthshire the following year to work at Buchanty lint mill.

In 1757 he entered the service of Dr. Adam Drummond of Gardrum, at whose mill he worked until 1760. During this time he also supervised the sowing of flax seed.

In 1761, with recommendations from Drummond, Campbell moved yet again, this time to Killin, where he oversaw another lint mill. After one year at this mill, he spent three years as a lint heckler before returning to lint dressing, this time at Crieff. In 1764 he was again seeking a post as the manager of a lint mill⁸⁹.

Despite some obvious mistakes such as the lint boor scheme the Board of Trustees achieved a fair degree of success in teaching and dispersing the skills necessary to operate the rapidly growing number of lint mills. This success was all the greater when one considers the limited assets available to them and the novelty of the technology employed, and while complaints against lint millers were common, the blame did not necessarily lie with the Board. Altogether at least fifty millers were trained at the Board's expense, an achievement which, along with a great mobility, both social and spatial, went a long way towards

fulfilling the needs of the industry.

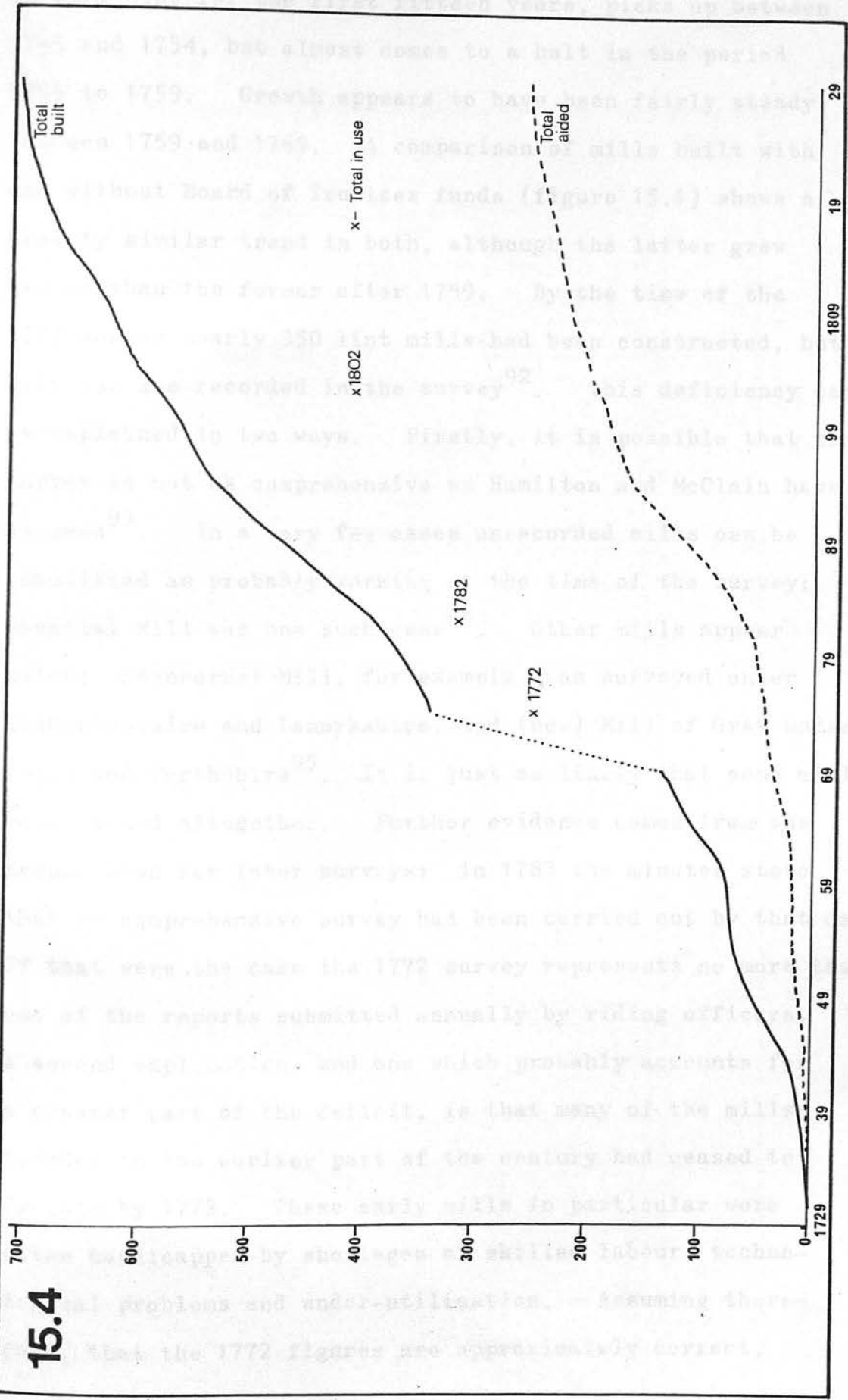
The Mills on the Ground

Numbers

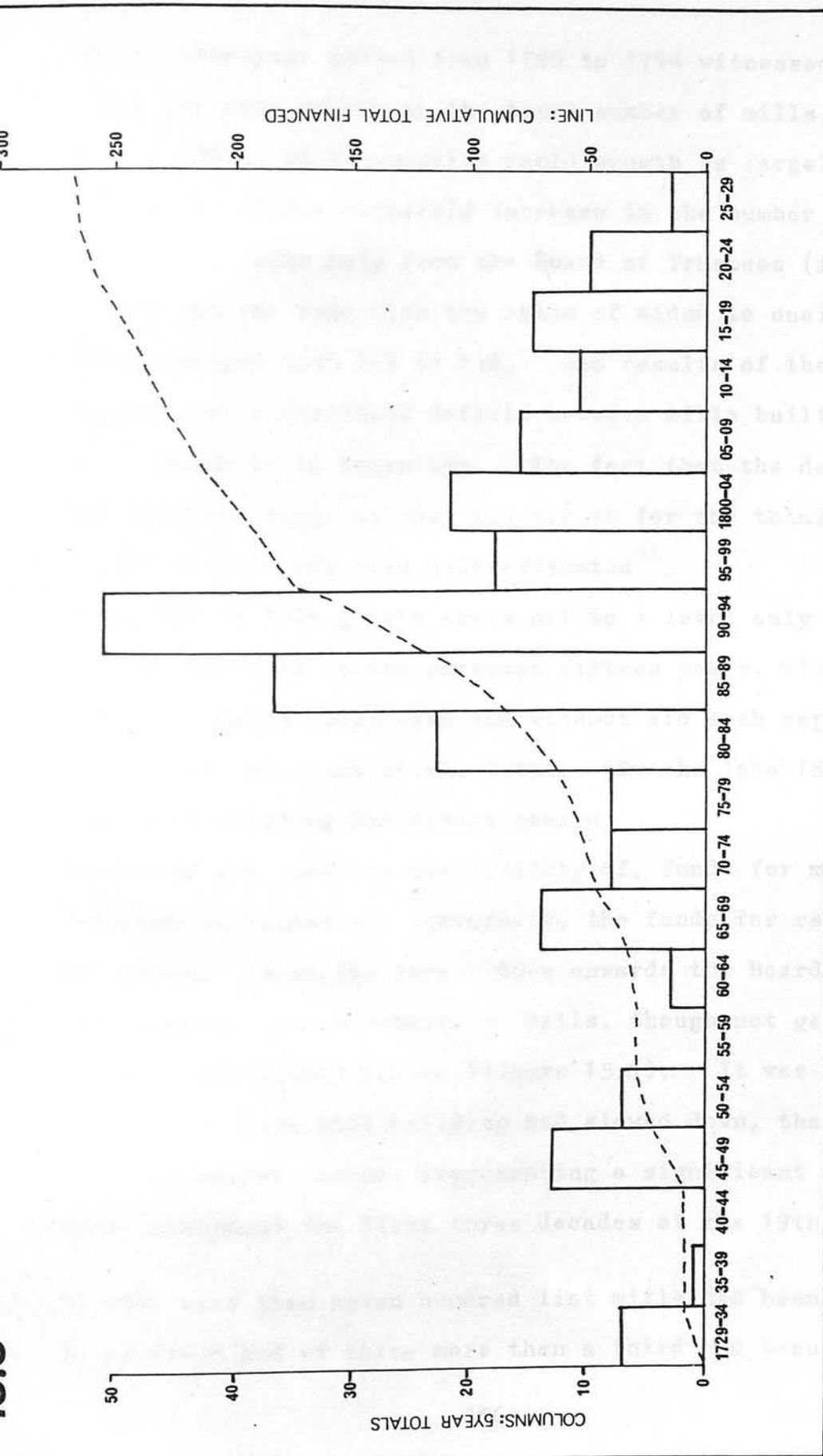
The little work that has so far been done on Scottish lint mills has not been able to establish the number of mills actually built⁹⁰. Indeed, it would be quite a daunting task to assess the number for, with the exception of early 18th century figures and the 1772 and 1782 surveys, researchers have had no comprehensive figures to work from. Impossible as it is to identify every single lint mill ever built, it should be possible, through the voluminous minutes of the Board of Trustees⁹¹ and other sources, such as county plans and the OSA to establish the minimum number of mills built by a given time, though not necessarily the number in operation. Used in conjunction with the Board's own surveys of 1772 and 1782, these figures can give some indication of "turnover" through abandonment or change of use, while a known starting point of 1729 and the figures from the first Ordnance Survey maps (1848 - 1880) help to define the beginning and the end of the lint mill. Figure 15.4 shows the cumulative number of mills known to have been built, at five-yearly intervals from 1729 to 1829. The substantial gap between the figures for 1769 and 1774 is the result of many mills going unrecorded until the 1772 survey and, that being the case, one can safely assume that figures for the years before 1744 are higher than those plotted.

Whether or not it reflects real patterns, the growth rate

15.4



is very slow for the first fifteen years, picks up between 1745 and 1754, but almost comes to a halt in the period 1755 to 1759. Growth appears to have been fairly steady between 1759 and 1769. A comparison of mills built with and without Board of Trustees funds (figure 15.4) shows a broadly similar trend in both, although the latter grew faster than the former after 1759. By the time of the 1772 survey nearly 350 lint mills had been constructed, but only 252 are recorded in the survey⁹². This deficiency can be explained in two ways. Firstly, it is possible that the survey is not as comprehensive as Hamilton and McClain have assumed⁹³. In a very few cases unrecorded mills can be identified as probably working at the time of the survey: Hospital Mill was one such case⁹⁴. Other mills appear twice: Edinbarnet Mill, for example, was surveyed under Dunbartonshire and Lanarkshire, and (new) Mill of Gray under Angus and Perthshire⁹⁵. It is just as likely that some mills were missed altogether. Further evidence comes from the preparation for later surveys: in 1783 the minutes state that no comprehensive survey had been carried out by that date. If that were the case the 1772 survey represents no more than one of the reports submitted annually by riding officers. A second explanation, and one which probably accounts for a greater part of the deficit, is that many of the mills founded in the earlier part of the century had ceased to operate by 1772. These early mills in particular were often handicapped by shortages of skilled labour, technological problems and under-utilisation. Assuming therefore, that the 1772 figures are approximately correct,



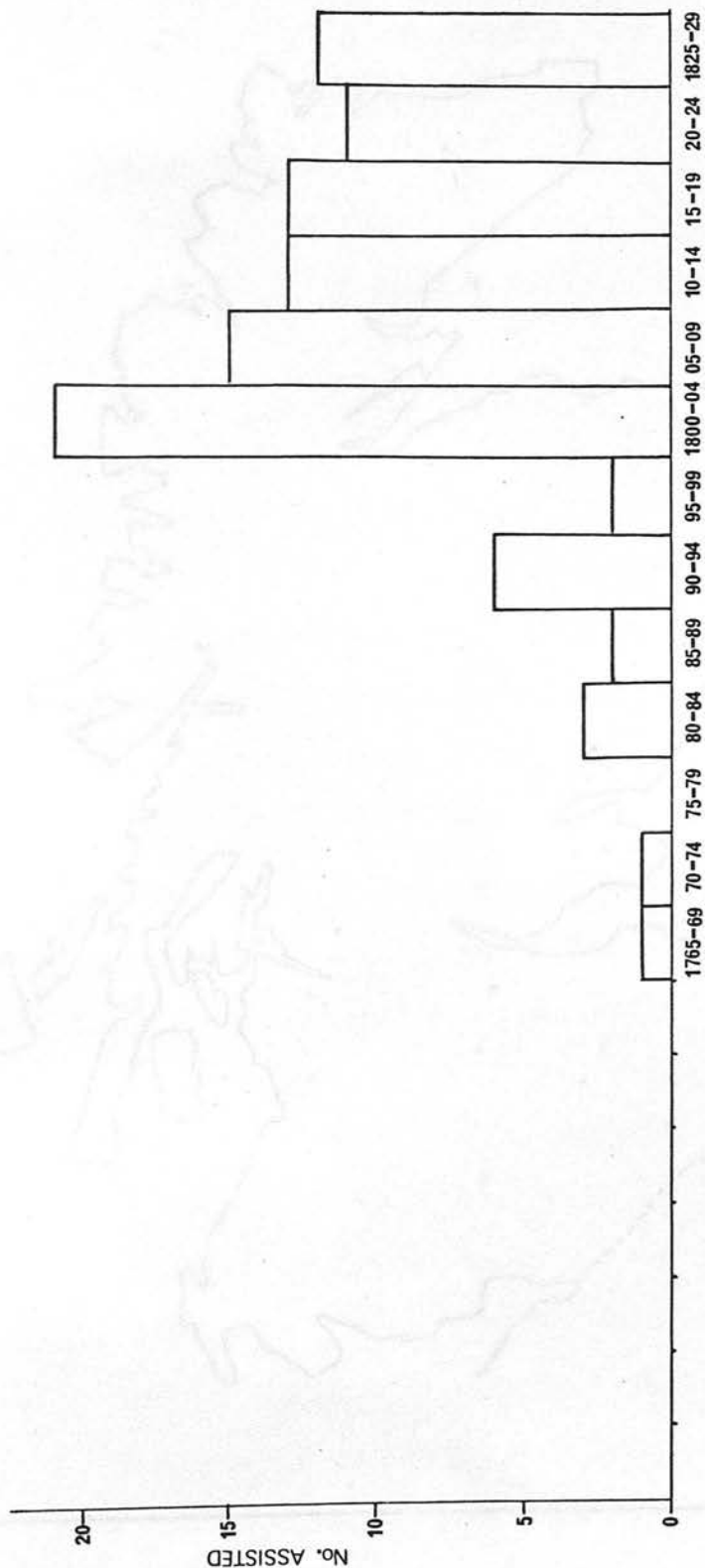
it is clear from figure 15.4 that by that time mills built without public funds far outnumbered those built with such funds.

The fifteen-year period from 1780 to 1794 witnessed a fifty per cent growth in the total number of mills, from 364 to 538. This unusually rapid growth is largely accounted for by the almost threefold increase in the number of mills built with help from the Board of Trustees (figure 15.5); at the same time the ratio of aided to unaided mills changed from 1:5 to 1:2. The results of the 1782 survey show a continued deficit between mills built and mills known to be operating. The fact that the deficit has narrowed suggests that the figure for the total number of mills built has been underestimated⁹⁶.

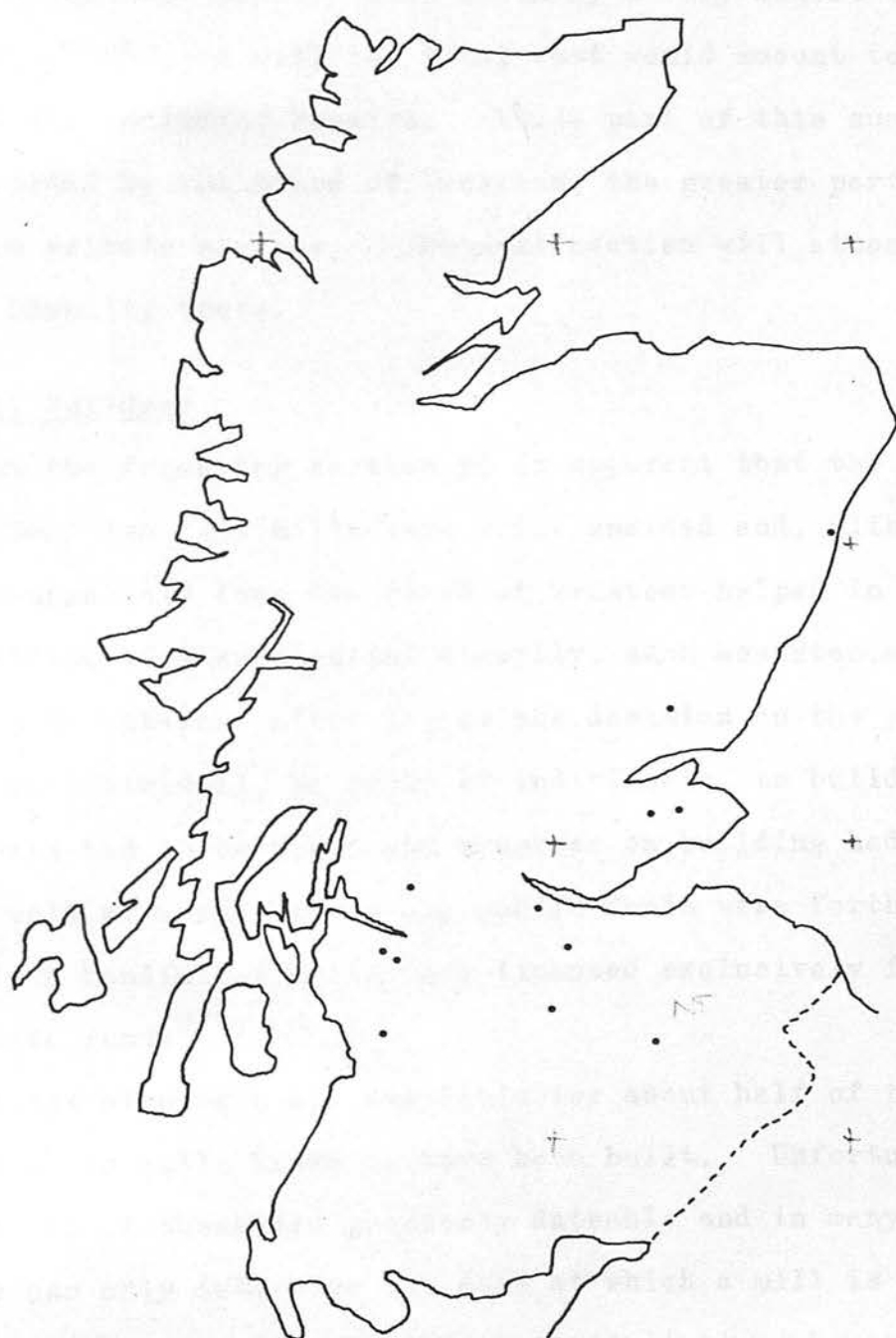
From 1794 to 1825 growth eases off to a level only half that experienced in the previous fifteen years, with the number of mills built with and without aid each representing about fifty per cent of the total. By the late 1820's lint mill building had almost ceased.

As demand for, and the availability of, funds for mill building decreased so, conversely, the funds for rebuilding increased. From the late 1760's onwards the Board had occasionally funded repairs to mills, though not generally to those previously helped (figure 15.6). It was only after 1800, once mill building had slowed down, that the practice became common, representing a significant investment throughout the first three decades of the 19th century.

By 1830 more than seven hundred lint mills had been built in Scotland and of these more than a third had been parti-



15.7 1729-44



ally financed by the Board of Trustees. Considering that no mills had existed prior to 1729 this represented a major success for the Board's policy of encouraging mill building, even if some of these mills ran inefficiently once built. It also represented a large-scale investment in industrial plant: even assuming a very modest construction cost of £80 per mill the total cost would amount to £56,000 excluding repairs. While part of this sum was provided by the Board of Trustees, the greater part came from private sources. The next section will attempt to identify these.

Mill Builders

From the foregoing section it is apparent that the majority of Scottish lint mills were built unaided and, although financial aid from the Board of Trustees helped in the building of a substantial minority, such assistance could only be obtained after a previous decision on the part of an individual, or group of individuals, to build.

A site had to be found and progress on building had to be well advanced before any public funds were forthcoming; only a handful of mills were financed exclusively from public funds⁹⁷.

Details of origin are available for about half of the 700 or so mills known to have been built. Unfortunately not all of these are precisely dateable and in many cases one can only determine the date at which a mill is first recorded. Bearing in mind these limitations however, it is still possible to group mills chronologically in terms of date built or date first identified and on this

basis to establish the social background of those financing mill construction. Nor is this limitation as great as it may initially seem to be for the 1772 survey, being nearly comprehensive, all the mills first referred to in the period immediately afterwards must date from that same period.

The years between 1729 and 1745 saw, for the first time, the establishment of lint mills in Scotland. Being an untried technology and one not widely known to exist, it is not surprising to find that almost all the mills built before 1745 were the work of landowners who were, in addition the only group to possess, at that time, sufficient financial and natural resources to establish mills. Notable among them was Hope of Rankeillor, the well known improver, whose Hospital Mill became the Board's training centre⁹⁸ (see pp.244-5). In a few cases the initiative lay elsewhere: in 1735 the Linen Society of Glasgow set up a lint mill in a converted waulk mill⁹⁹ and in Renfrewshire one early mill was financed by the Magistrates of Paisley, another by a farmer and a customs officer¹⁰⁰. Between 1745 and 1760 the social status of mill builders began to diversify. In those counties in which mills had already been established, such as Perthshire, Renfrewshire and Midlothian, landowners were joined by tenants and workers in the textile trades such as bleachers, dyers and flax dressers. In those counties where no mills had existed before 1745 and where few were built by 1760, the pioneering work was usually left to landowners, although not always to those with the improving status of

Grant of Monymusk or Lord Belhaven, both of whom established lint mills c. 1750¹⁰¹. In one or two cases workers in the textile trades built mills in these outlying areas: in Roxburghshire, for example it was a weaver and in Banffshire a flax dresser who built the first mills in those counties¹⁰².

In the period 1760 - 1772 the pattern develops still further with mill or farm tenants joining the ranks of mill builders in such counties as Perthshire, Angus and Lanarkshire where mills had become well-established. While this may appear to be an important development a tenant could not usually obtain help from the Board of Trustees if his disinterested or hostile landlord failed to give his support, financial or otherwise¹⁰³. On the other hand some landowners showed an enlightened attitude to providing credit facilities or, as at Moulin in Perthshire, by entering into a cost-sharing agreement with a tenant¹⁰⁴.

An increasingly common practice was for the site of a proposed lint mill to be taken on feu¹⁰⁵.

Areas which had been marginal prior to 1760 now showed signs of diversifying: in Aberdeenshire, for example, flax dressers often built their own mills but in those counties which were still marginal, such as Berwickshire and Ross-shire, most of the initiative continued to come from the landowning class.

For the remainder of the 18th century developments in established areas continued to follow the same lines as formerly. The diverse trades to which mill builders belonged came to include masons, millwrights, joiners,

ministers and advocates besides the more numerous textile workers and tenants of farms and mills¹⁰⁶. In these established areas landowners continued to play a role in mill building. In marginal areas it was often major landowners or other improvers who introduced lint mills: Grant of Grant and the Duke of Gordon both built mills in Inverness-shire, as did Sinclair of Ulbster in Caithness¹⁰⁷.

A certain amount of interest was also being shown by merchants and manufacturers, either individually or in partnership. The early example of the Glasgow Linen Company has already been cited (p. 258); in 1756 the British Linen Company had incorporated a lint mill in their Saltoun bleachfield and the rest of the century saw an increasing involvement by local merchants and manufacturers, particularly in the north and east¹⁰⁸.

Between 1800 and 1830 the building of new mills and the cultivation of flax declined rapidly (p. 256). Merchants and manufacturers were involved in financing only one mill and landowners only a handful; for the most part construction was undertaken by farm or mill tenants in areas where flax cultivation was well established. Elsewhere, and in other social groups, interest in lint mills was waning rapidly.

Despite the occasional involvement of merchants, manufacturers, local authorities and members of the legal profession, their overall significance never reached very great proportions. The vast majority of mill builders were essentially rural in background. Some owned, feued or rented land,

some were involved in small scale textile trades such as heckling, while others had experience in constructing or operating mills. In this respect Scottish lint mills were more closely allied to corn and other grain-processing mills than to the mills built to serve the other, more highly capitalised branches of the linen industry. Although the data imposed some limitations it is possible to discern a regular pattern of development, with an initial commitment by landowners and a subsequent contribution by tenants and other essentially rural groups. This progression was repeated in each area into which lint mills were introduced, up to about 1800, after which the prolonged decay of the flax-growing industry led to a gradual reduction in those areas in which new mills were built, until about 1830, by which time only a few tenants and landowners in isolated corners of Central Scotland or upland Perthshire were prepared to put up money for the construction of lint mills, the last ever to be built in Scotland.

Distribution

Most of our ideas about the distribution of lint mills are based on the results of the 1772 survey which, with the exception of Wares Mill, Caithness, were plotted by McClain¹⁰⁹. While these distributions are probably accurate enough for the time to which they relate, they give no idea of the spatial development of the industry before or after that date. The difficulties in obtaining comprehensive figures have already been discussed (p. 254). Nevertheless a fairly comprehensive list can be drawn

up from manuscript sources such as the Minute Books of the Board of Trustees, the Records of the Forfeited Estates Commission and a variety of estate documents, besides published sources such as the Old Statistical Account, the New Statistical Account and county plans.

Bearing in mind their limitations it should still be possible to obtain a clear picture of the number of mills built in any area by a certain time and a less clear but still useful impression of the locality of those mills actually operating.

Figure 15.7 shows the number of mills built or first referred to in the period 1729 - 1744. Most of the twenty mills built before 1745, for which locations are known, occupy a broad belt across central Scotland from Renfrewshire in the south-west to Angus in the north-east, with two eastern outliers, Aberdeenshire and Berwickshire. While there are no references to Perthshire mills some probably did exist but independently of the Board's activities.

The distribution of mills in figure 15.8 (1745 - 1760) reinforces this view to some extent, with no less than twenty-one Perthshire mills recorded for the first time. The strongest development occurred in east Central Scotland in an area which included Midlothian in the south. Developments in west Central Scotland were less marked, but mills had begun to spread outwith the central area into south-east Scotland and from Aberdeenshire to the Moray Firth area. In Argyll the establishment of mills is surprisingly strong, owing much to the work of major

15.8 1745-59



15.9 1760-72



landowners such as Campbell of Barcaldine¹¹⁰. Indeed the wider spread of mills generally owes much to the innovating role of enlightened landowners. As the survey of 1772 gives the first comprehensive review the very high figures for the period 1760 - 1772 must reflect to some extent, a backlog of sites from earlier periods. The pattern that emerges (figure 15.9) tends to reinforce that of earlier times: a strong concentration in the Central Lowlands with extensions into the straths of Perthshire and round the eastern coastal fringe. In west Central Scotland the lag in growth between 1745 and 1760 may have been more apparent than real, although the apparently strong growth in the period 1760 - 1772 may be partly attributable to the transfer of flax-growing premiums in 1763 from Perthshire, Fife and Forfarshire to Dunbartonshire, Lanarkshire, Stirlingshire, Renfrewshire and Ayrshire¹¹¹. Nevertheless, it is difficult to accept that the number of mills in Dunbartonshire jumped from nought to eighteen in so short a time.

The diffusion outwith Central Scotland already noted in this and the previous section, continued with consolidation in Aberdeenshire and Banffshire so that by 1772 lint mills had been built in all but five of the counties of the Scottish mainland. As for the number of mills actually working, figure 15.10 shows that the counties of west Central Scotland were on a par with those of the east by 1772 assuming, that is, that the survey is comprehensive. It is interesting to note that none of the six mills built in Argyll and only two of the ten in Midlothian are listed.

15.10 1772



Omissions apart, this suggests that most of the mills in these "marginal" areas had been short-lived and of limited viability.

While the figures for 1773 - 1789 (figure 15.11) may not be comprehensive, there is little chance of their including mills built before the 1772 survey. The most striking change is the widespread diffusion of mills from the Central Lowlands into the Borders, Galloway and Inverness-shire. In contrast very little building took place in the area around east Dunbartonshire which had previously experienced extensive mill construction. In Inverness-shire the Duke of Gordon and Grant of Grant were among those who built mills, but in the Borders and Galloway the initiative often lay with smaller landowners or with millers and farmers.

It would appear from figure 15.12 that the area in which lint mills were still being built in the 1790/s was already contracting and that the principal area had shifted on to a more polar axis, running from Buchan to north-eastern Lanarkshire. The Dumfries area and the straths of Perthshire continued to show significant new building while Kincardineshire, a county formerly with very few mills, saw extensive mill construction. It is tempting to see the sparseness of new mills in west Central Scotland as a reflection of the displacement of linen by cotton; certainly during the two decades up to 1800 the area had experienced a meteoric rise in the number of water-powered cotton mills and of "jenny" mills in Glasgow itself. What is more, the amount of linen cloth produced there

15.11 1772-89



15.12 1790-99



was falling sharply¹¹². However, much more research, outwith the scope of the present enquiry, would be necessary to establish a direct causal relationship. Various writers have recognised a switch in west Central Scotland from linen to cotton and McClain goes so far as to imply that in this area lint mills were practically extinct by the 1790/s¹¹³.

The distribution pattern for new mills in the period 1800 - 1814 (figure 15.13) does not really tally with such a view. By far the strongest concentration is in the poorer land of Central Scotland between Edinburgh and Glasgow. Elsewhere too it is the more isolated mills, on poorer land, which make up the bulk of the sites: upland Perthshire, Kirkcudbrightshire and Cunninghame all figure prominently.

This "retreat" can be ascribed to at least two forces. Firstly, the availability of good land for flax cultivation was very restricted. For some time flax had suffered the reputation of being an "exhausting" crop which took nutrients from the soil without replacing them¹¹⁴. While this view was still being challenged in the early 19th century, it was probably the Napoleonic wars which drove flax cultivation off much of Lowland Scotland.

The impact of the wars on arable cultivation is well documented¹¹⁵ and can still be seen in the broad green rigs which flank the margins of present day cultivation. And just as the need to grow food crops created a boom in grain mill construction so, conversely, it led to a slump in flax cultivation and lint mill construction.

15.13 1800-14



Only on the poorer lands, such as those in the great empty heart of Central Scotland, could flax compete.

The second major factor was the mechanisation of flax-spinning which, while by no means perfected, increased the centralisation of spinning and the use of imported flax at the expense of the locally grown and spun product. Furthermore, it should be borne in mind that while the overall impression is one of decline in east Central Scotland there is reason to believe that many existing mills, built before 1800, continued to operate at least for a decade or so after that date.

In the post-war period (figure 15.14) the further decline of flax mill building is apparent with an even more marked centralisation on mid-Central Scotland. By 1815 Lanarkshire was the most important flax growing county in Scotland and ranked first among those counties where new mills were being built¹¹⁶. In much of Lowland Scotland cotton had taken over the role formerly held by linen and while the volume of the home crop fluctuated widely the difficulties in cultivating flax, already referred to, can hardly have helped its position vis a vis cotton or imported flax. In the traditional flax-growing region of east-Central Scotland mill spinning was becoming the rule, using imported flax, and often employing the sites occupied previously by lint mills.

Mid-Central Scotland continued to occupy a leading role for the decade that the truncated flax industry survived after 1830: of the forty or so lint mills mentioned in the New Statistical Account (c.1834-45) eleven lay in a

15.14 1815-30



belt between western West Lothian and north-east Lanarkshire, twelve in the Grampian area and five in south-west Scotland. In contrast only two were mentioned in Fife, five in Perthshire and one in Angus¹¹⁷. Many of these forty were little used although one in Kirkmichael parish, Ayrshire, was still dressing two hundred stones of flax per annum¹¹⁸. About an equal number of mills appear in the first Ordnance Survey maps (c.1848-1878), half of these in mid-Central Scotland and a substantial part of the remainder in upland Perthshire. Over much of Scotland, however, the lint mill had long since passed into history. Figure 15.15 shows the distribution of all mills known to have been built in Scotland.

15.15



A Scottish Lint Mill

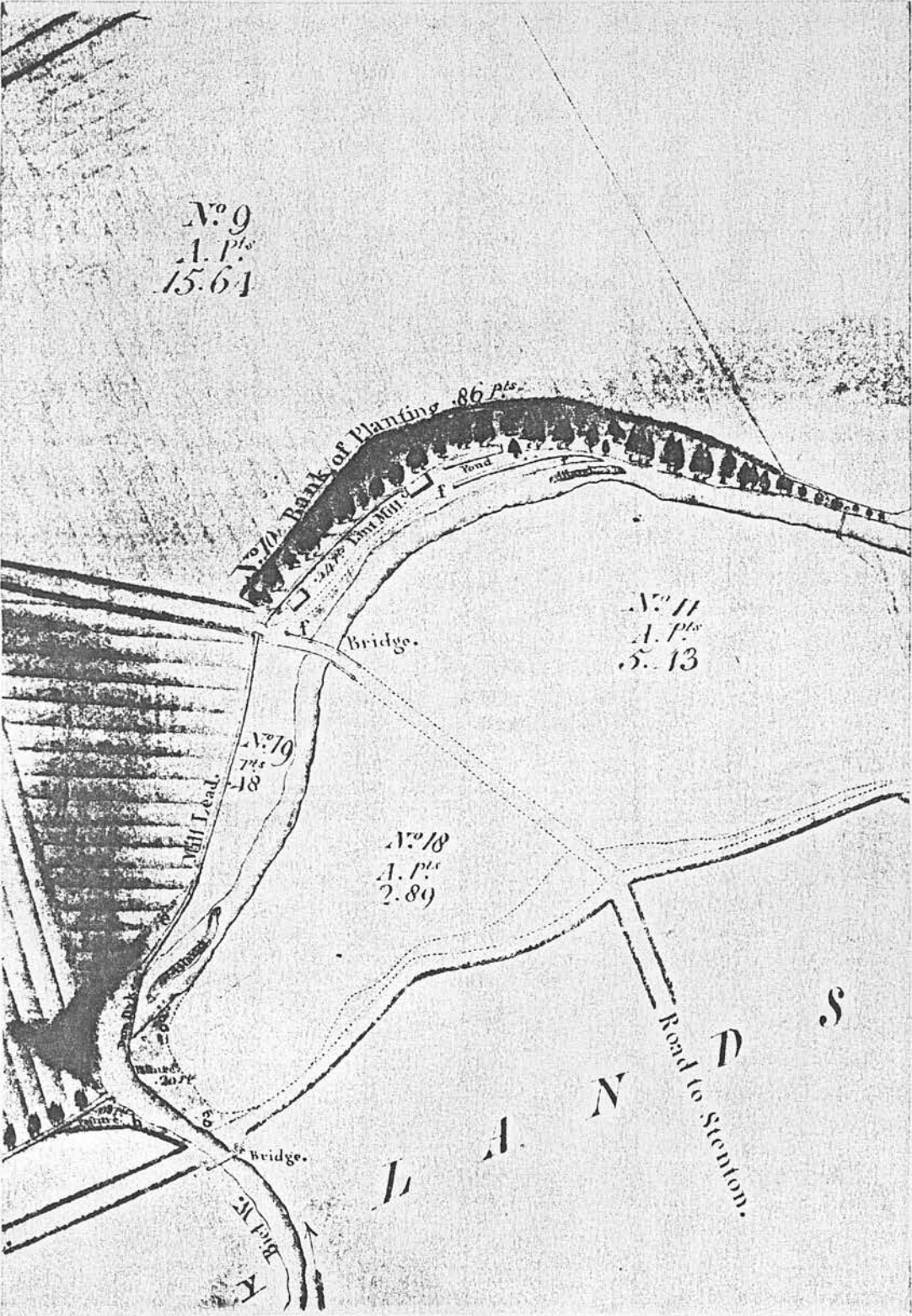
Grangehaugh Mill, East Lothian

Before concluding this chapter it might be helpful to draw together the preceding sections by examining in depth one mill which illustrates most of the points made therein. No mill suits this purpose better than Grangehaugh Mill, East Lothian, for while its situation is hardly central to the flax-growing regions of Scotland, its unusually good documentation reveals a complex history which exemplifies most of the features already referred to in a general context.

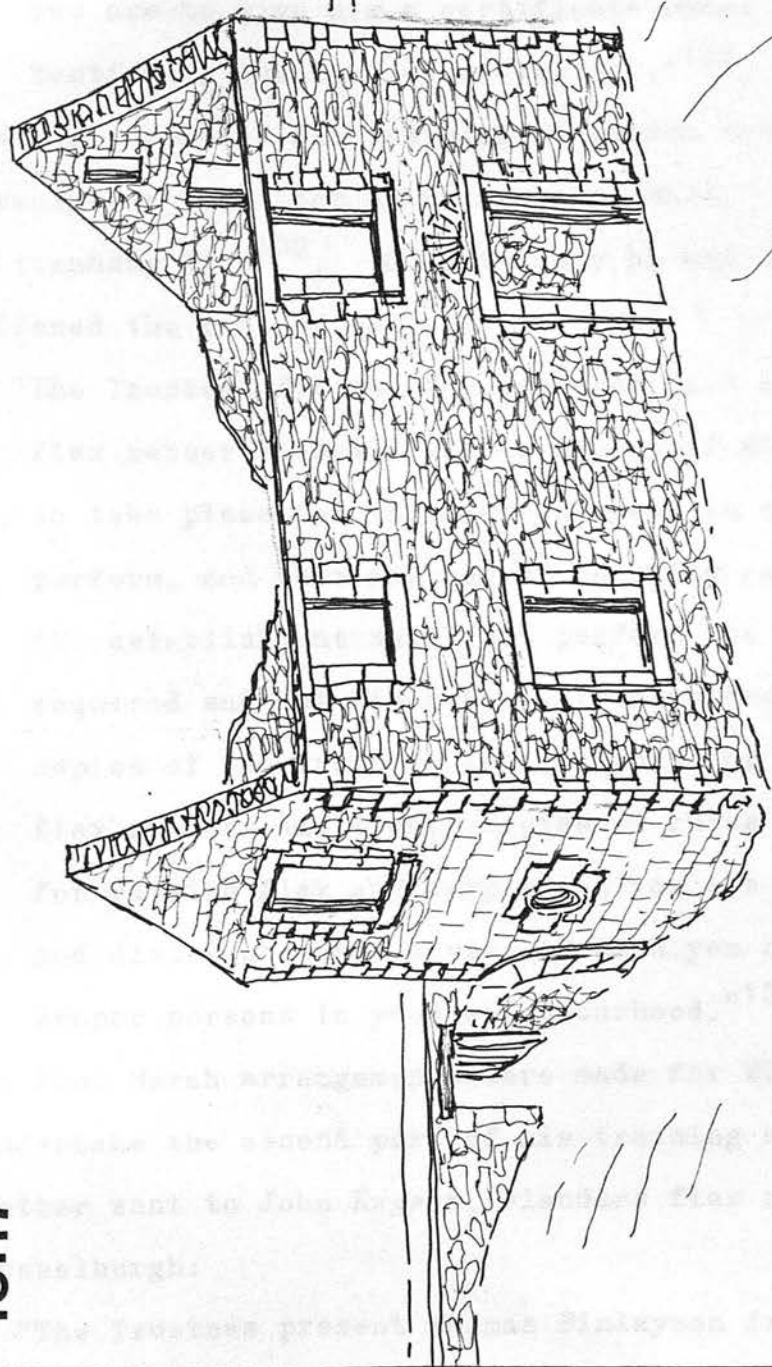
Grangehaugh Mill was constructed in 1750 by Lord Belhaven, an Improving landowner and a member of the Board of Trustees for Manufactures¹¹⁹. The site chosen was on the northern side of Biel Water at the western edge of Biel estate in the parish of Stenton (figure 15.16). From the remains still visible today (figure 15.17) the mill would appear to have been a two-storey, red-sandstone rubble building with well-faced jambs and lintels and a breast-shot wheel of about ten feet in diameter. The ark, also in well-faced stone, fits closely around the site of the wheel and the mill may have been the work of the Meikle brothers: by the early 1750's Andrew Meikle had taken up residence at Houston Mill, only three miles away¹²⁰. This, with the attested expertise of the Meikles in lint mill design (p. 238), would have made him an obvious choice.

On 12th January 1750 the Board's secretary wrote to John Ness at Hospital Mill asking that one Thomas Finlayson from the parish of Stenton and Shire of Haddington

15.16



15.17



"be instructed by you in all your art of breaking.

bruising and swingling fflax (sic) by the miln, and

in every art and mystery concerning the dressing flax

by the miln and concerning the miln itself so far as

you know or practise yourself; you are to pay him

of wages for his work while with you at the rate of

3d each day he works; so soon he is fully instructed

you are to give him a certificate under your hand

testifying the same accordingly..."¹²¹

Having completed his training Finlayson entered into a

twenty-one year tack of Grangehaugh Mill, to run from

Whitsunday 1750¹²². On 24th July he was conditionally

offered the post of raiser:

"The Trustees for the Manufactures have appointed you

flax raiser at Beild with a salary of £15 by the year

to take place for this current year in case you shall

perform, and that any one of the flax raisers now on

the establishment shall not perform the conditions

required and not otherways - I therefore send you ten

copies of the Trustees instructions for their stationed

flax raisers and twenty copies of rules and directions

for raising flax and hemp which you are to observe

and distribute what copies of each you can spare to

proper persons in your neighbourhood."¹²³

On 22nd March arrangements were made for Finlayson to

undertake the second part of his training and the following

letter sent to John Keysar, Flanders flax raiser at

Musselburgh:

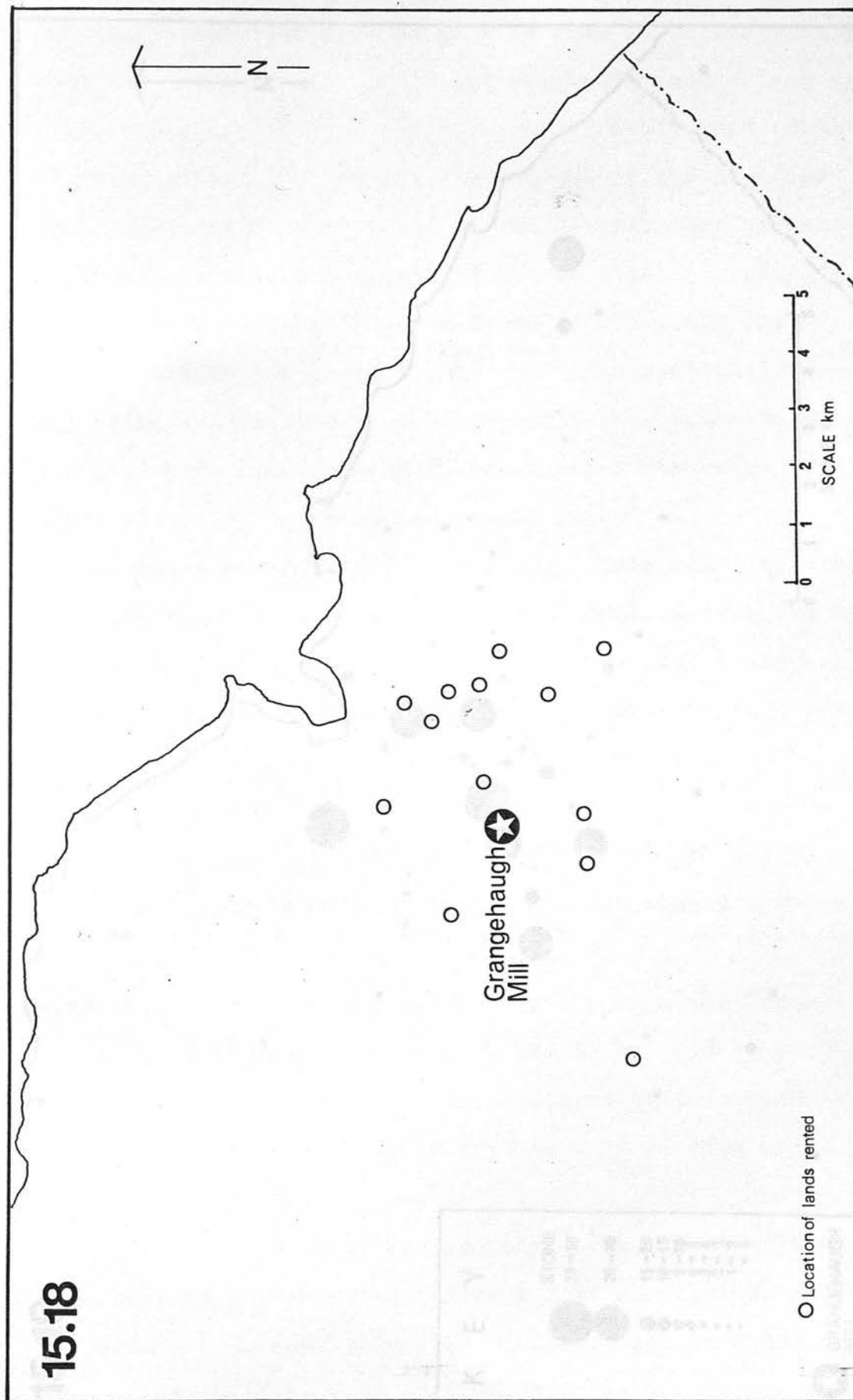
"The Trustees present Thomas Finlayson from Beild in

the shire of Haddington, to be instructed by you in all your art of raising flax, that is to say the preparing the ground, pulling, watering, grassing and every other part of the mystery by you known or practised. You are also to instruct him in the art of swingling by stock & hand - you are to pay him of wages for his work while with you at the rate of three pence sterling each day he works for the first month & five pence sterling each day he works for the other five months. So soon as he is fully instructed, you are to give him a certificate under your hand, testifying the same accordingly."¹²⁴

In June 1750 the Board had considered James Brown at Beesknowe, on the Biel estate, as a possible lint boor for the following year¹²⁵ but as tacksman of a lint mill Finlayson was a more obvious choice. Early in 1751 he was promised a post as lint boor¹²⁶. Finlayson already had a mill and by May of that year, having fulfilled his commitment to sow twenty acres of flax, he was given his £140¹²⁷. On 5th March 1751 his post of raiser had been confirmed, with an obligation to raise ten acres¹²⁸; thus, within eighteen months of starting his training, Finlayson had earned the double distinction of being both lint raiser and lint boor.

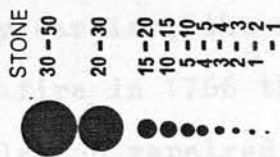
Besides dressing flax from lands rented by Finlayson (figure 15.18) the mill also took in flax grown by other individuals at farms throughout the eastern half of the county. Figure 15.19 shows the origin of flax dressed between December 1751 and August 1752.

15.18

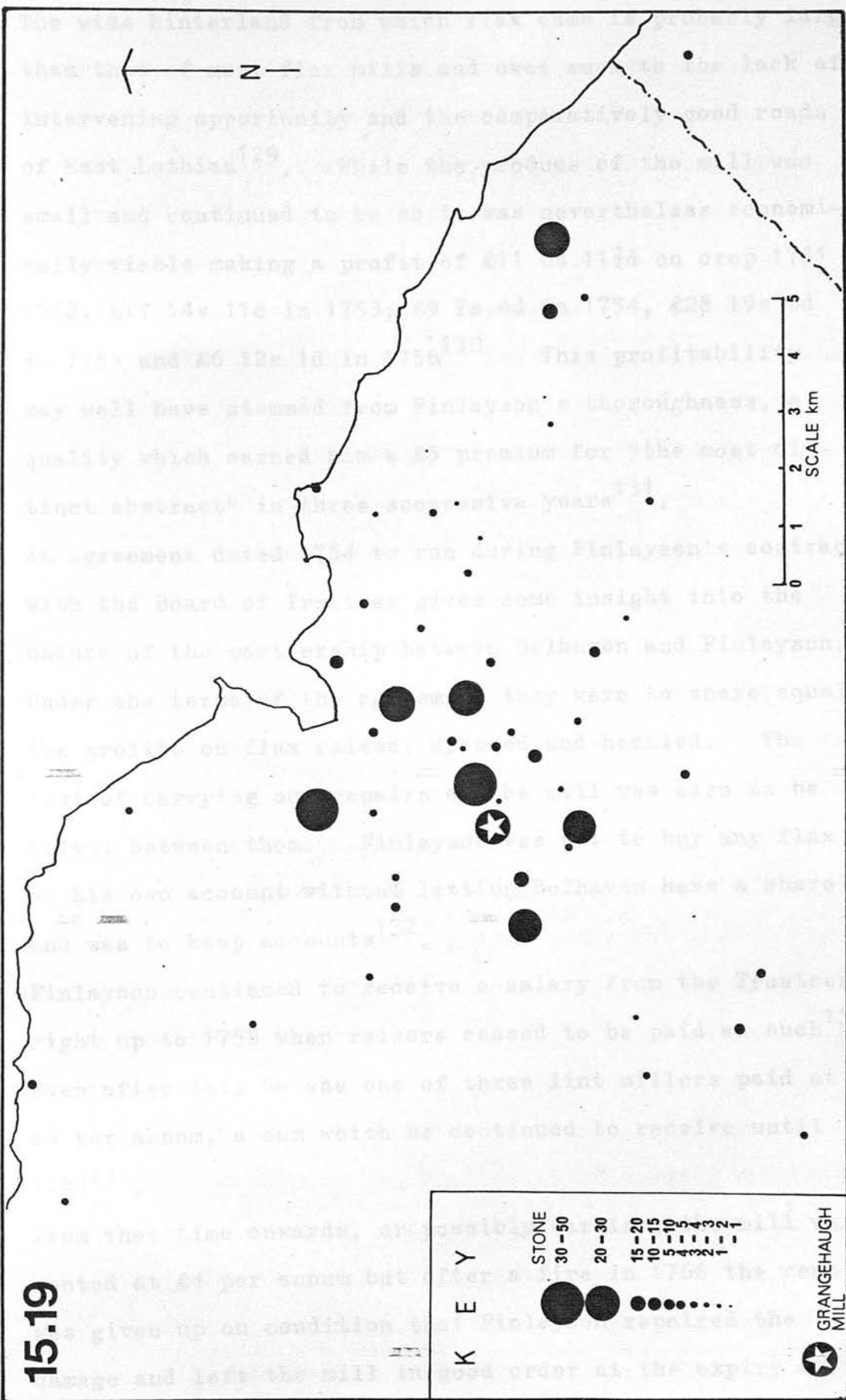
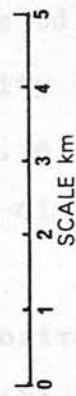


15.19

K E Y



GRANGEHAUGH
MILL



The wide hinterland from which flax came is probably larger than that of most flax mills and owes much to the lack of intervening opportunity and the comparatively good roads of East Lothian¹²⁹. While the produce of the mill was small and continued to be so it was nevertheless economically viable making a profit of £11 0s 11 $\frac{3}{4}$ d on crop 1751 - 1752, £17 14s 11d in 1753, £9 7s 4d in 1754, £28 19s 6d in 1755 and £6 12s 1d in 1756¹³⁰. This profitability may well have stemmed from Finlayson's thoroughness, a quality which earned him a £5 premium for "the most distinct abstract" in three successive years¹³¹. An agreement dated 1754 to run during Finlayson's contract with the Board of Trustees gives some insight into the nature of the partnership between Belhaven and Finlayson. Under the terms of the agreement they were to share equally the profits on flax raised, dressed and heckled. The cost of carrying out repairs on the mill was also to be halved between them. Finlayson was not to buy any flax on his own account without letting Belhaven have a share and was to keep accounts¹³². Finlayson continued to receive a salary from the Trustees right up to 1758 when raisers ceased to be paid as such¹³³. Even after this he was one of three lint millers paid at £5 per annum, a sum which he continued to receive until 1763¹³⁴. From that time onwards, or possibly earlier, the mill was rented at £4 per annum but after a fire in 1766 the rent was given up on condition that Finlayson repaired the damage and left the mill in good order at the expiry of

his lease¹³⁵.

In the survey of 1772 Grangehaugh Mill receives a good report. The supply of water was adequate for nine months of the year; flax was broken by rollers while the perpendicular scutchers provided space for nine persons to work simultaneously. The loft was said to be "prety large" and capable of holding a considerable quantity of flax while the machinery and the "sufficiency" of work were both considered to be good. All in all, the impression is of a large, well run mill and despite its small volume of business (159 stones, crop 1770) rates for scutching and heckling were kept down to 2s and 1s per stone Tron respectively¹³⁶.

Under the lint boor scheme of 1772 both Finlayson and James Wood, a heckler from Stenton village, were accepted for posts. It soon became apparent however, that neither would be able to find the necessary housing and accommodation¹³⁷; in all probability Finlayson had failed to obtain a renewal of his previous twenty-one-year tack. In March 1773 the Board refused to pay them £3 per acre for the little flax they had planted¹³⁸ and in the following July Finlayson was dropped from the scheme¹³⁹. After this no more is heard of him.

By 1778 the mill had come into the possession of Angus McPherson. McPherson had trained at Elie under McDonald (p. 251) and had shown some success as a lint boor in the Merse, despite difficult circumstances. It is not easy, therefore, to reconcile this with the state of affairs which existed in 1778 - 1779. In 1778 local

farmers petitioned the Board of Trustees requesting that another lint mill be built¹⁴⁰. The Board decided to make enquiries into the quantity of flax dressed at the mill, the best site for a new mill and who would build it¹⁴¹. Shortly afterwards, in a second petition, the farmers claimed that they were unable to have their 1776 crop dressed for want of a lint mill in the county¹⁴². The situation cannot have been rectified that year for in January 1779 the Board received yet another complaint¹⁴³. This lapse is not easily explained; on the basis of the low figures for 1772 it is hardly likely that demand for dressing had outstripped the capacity of the nine-port mill unless there had been a particularly severe drought. Nor does it appear to be due to any deficiency on the part of McPherson; he had already gained a good reputation as a flax boor and a few years later, in 1782, was to be sent two apprentices, a privilege reserved for only the most favoured of lint millers. Whatever the cause the problem seems to have resolved itself. In 1781 the old paper mill at Gifford (pp.73-6) was converted to dress flax; this may have helped to take any pressure off Grangehaugh¹⁴⁴.

By 1785 the two apprentices, taken on in 1782, had completed their training and McPherson, now the Board's itinerant flax raiser, was given two more. Subsequent evidence suggests that he continued to take on apprentices on the Board's behalf, and at its expense, until at least 1794¹⁴⁵. Yet another apprentice was taken on in 1806, this time by John McPerson, probably the son of Angus¹⁴⁶.

The McPhersons benefitted from the Board of Trustees in other respects too. In the early 1790's Angus McPherson was granted £10 to build a flax storage shed and in 1806 another shed was built. For this latter and for renewing the mill's machinery John McPherson received £24¹⁴⁷.

The mill continued to operate until the second quarter of the nineteenth century although the minutes of the Board of Trustees contain no references to the mill, or to McPherson, after 1806¹⁴⁸.

Considering the mill's doubtful viability, even in the 1770's, its survival into the 1820's is very surprising.

East Lothian was never a major flax-growing county and the war years in the early 19th century must have all but driven the crop off its highly productive lands.

Once the mill had closed, or possibly in its later years as a working mill, the lade was modified to supply threshing mills at Biel Grange and Beesknowe¹⁴⁹. The age of flax growing was over; like so many other lint mills all over Scotland Grangehaugh had reached the end of its useful life.

Summary

"It must be acknowledged that, according to the present arrangement, the substitution of machinery in place of hand labour for preparing flax has obstructed instead of facilitating improvement in this branch of industry."¹⁵⁰

In the century between 1729 and 1830 the Board of Trustees, handicapped by a small and variable budget, had mechanised flax dressing, helped finance the building of some two

hundred and eighty mills and offered technical aid to others, had provided facilities and finance for the training of lint millers and had paid salaries to many of these once trained. Together with private individuals they had built over seven hundred mills using machinery previously unknown in Scotland. Why, then, is the consensus view, among both contemporaries and historians, one of failure?

To some extent the blame must lie with the Board of Trustees. Although they encouraged flax-growing they could not guarantee that mills would be available to dress it nor prospective buyers to take it off their hands. The lint boor scheme, involving an investment of £140 per person over a three-year period, was at best misguided and at worst foolhardy, failing, as it did to take account of Scottish conditions. However, as Naismith was later to concede, the task of co-ordinating the introduction of flax cultivation and of lint mills was an extremely difficult one¹⁵¹. Furthermore the financing of mills was open to abuse although to give them their due the Trustees did try to crack down on this in later days. All things considered however, their worst crime was to hope for too much too soon and on too small a budget.

Where then did the blame lie, if not with the Board of Trustees? According to Lord Kames the root of the problem lay in "the indolence and ignorance of the low people, and their want of honesty"¹⁵². Indeed, human failings accounted for many of the inadequacies found in lint mills. Lord Kames makes a criticism traditionally directed at

corn millers: worked at their trade during the summer

"the lint miller, being under no check nor control.

is tempted to defraud his customers of part of their dressed flax: and there are instances where the whole has been withheld from poor people, who it was thought would not have courage to bring a law suit."¹⁵³

Naismith blamed the lack of skilled labour:

"The millers, keeping no more hands than what are barely necessary to expose the flax to the action of the machine, and those preparers not being deeply interested in the success of the operation, the work is often passed over in a slovenly manner, and all kinds of flax subjected promiscuously to the same treatment without any pains being taken to distinguish their different qualities".¹⁵⁴

Whatever the Board's efforts in training a skilled labour force they were, in effect, unable to overcome the problems of an essentially seasonal industry. The 1772 survey shows that at the best mills, such as Elie, labour was engaged for the whole year. In one case, at Quartalehouse, Aberdeenshire, the miller had brought an expert hand from Perthshire and between them they had trained the rest of the labour force which had been there ever since¹⁵⁵. On the other hand there were many lint millers, especially in the west of Scotland, who had to be content with hiring labour for the winter months only and not necessarily those hired the previous year. At a Banffshire mill, referred to by McClain, the miller had managed to accommodate the problem: three of his six employees

were masons who worked at their trade during the summer months and three were farmers who farmed all year round but worked at the mill in their spare time¹⁵⁶. At one stage the Board sought to rectify the situation by suggesting that mills be built alongside bleachfields, the latter providing work during the summer months: this was the system adopted at Cullen, Banffshire¹⁵⁷.

However, the policy had to be modified after a lint mill fire at Balgersho, Perthshire, which destroyed valuable bleaching machinery in 1768¹⁵⁸.

The human element in the form of either deliberate dishonesty or an unavoidable shortage of skilled labour was only one reason for the notoriety of lint mills. Another was the physical state of the mills themselves. At an early stage lint mills gained a reputation for damaging flax; Lord Kames claimed that:

"the ordinary yield of this mill in dressed flax is so much inferior in quantity to that of stock in hand as to overbalance fully what is saved upon labour; not to mention the hurt that is done to the flax by the violent and ill-directed action of the mill"¹⁵⁹.

Naismith believed that the momentum of ordinary scutching mills was too great and that the horizontal action of the scutching arm was too severe¹⁶⁰. He also suggested that flax dressers put too much faith in the powers of the mill: "By relying on the execution of the mill, the attention of the man is in a great measure removed"¹⁶¹. Despite his criticisms Naismith went on to clear the basic design principle from blame:

"The application of machinery would nevertheless be of great service, under proper regulations. Notwithstanding the clamour which disappointment has raised against skutching (sic) mills, there is nothing in the construction or impetus of these engines to prevent flax being cleaned by them in the most advantageous manner, provided the previous processes have been skilfully conducted, and the flax fitted to undergo the operation"¹⁶².

Not only the Board's experiments, but also those of Naismith himself confirmed his view¹⁶³.

Another shortcoming was the lack of storage facilities

"In many places there is not sufficient house-room provided for the flax that is brought to the mill; which in a throng time is often exposed to the air for months together before the miller can reach it"¹⁶⁴. Flax left out in the open often reached the mill in an unfit state, resulting in a poorly dressed product¹⁶⁵. The financial aid which the Board offered for shed building (p.242) and for experiments on drying ovens (p.243) probably went some way towards solving this problem.

A third set of difficulties arose from the siting and situation of mills. The most serious fault in siting was a failure to have sufficient command of water. This was alleviated to some extent by the seasonal nature of the lint mill's work but even so, many mills were seriously handicapped by dry spells, whilst low water, by slowing down the scutching arms, resulted in badly scutched flax¹⁶⁶. The situation of mills was not always the most convenient

for flax growers. Because of the scale and fixed capital cost (about £80 - £120) of lint mills the chances were that even in those areas where flax was widely cultivated some farmers would have to carry their flax several miles to be dressed. In more marginal areas, where a mill's hinterland was much wider (cf. Grangehaugh p. 271) and communications often difficult, the effort involved must have been a strong disincentive at a time when many small farmers did not even possess a cart¹⁶⁷. On the other hand there were those areas which had mills but which failed to produce a large enough crop to make them financially viable¹⁶⁸. The distance from markets, already referred to, (p. 271) must have been a further disincentive even to those farmers who had managed to get their crop to a mill. Granted, farmers in Angus, Fife or Perthshire could often sell their crop on the ground and the flax-buying powers vested in lint boors may have temporarily alleviated the situation in a few areas, but for the most part the problem remained unresolved¹⁶⁹.

A NOTE ON OIL MILLS

Although not strictly speaking a branch of the linen textile industry, oil mills logically belong with it inasmuch as their raw material was derived from flax grown for manufacture into linen. Seed, generally that unsuitable for propagation, was rippled or separated from the flax plant and crushed to produce an oil which found a ready market, both within and without Scotland, in the treatment of woodwork (especially furniture), in making varnish and, when mixed with ochre, in making a paint known as Spanish brown¹⁷⁰.

Technology

From specifications drawn up in 1780 for an oil mill at Mill of Struthill, Perthshire, it is possible to obtain a fairly detailed picture of the mechanics of a Scottish oil mill in the 18th century. (For complete specifications see Appendix I.

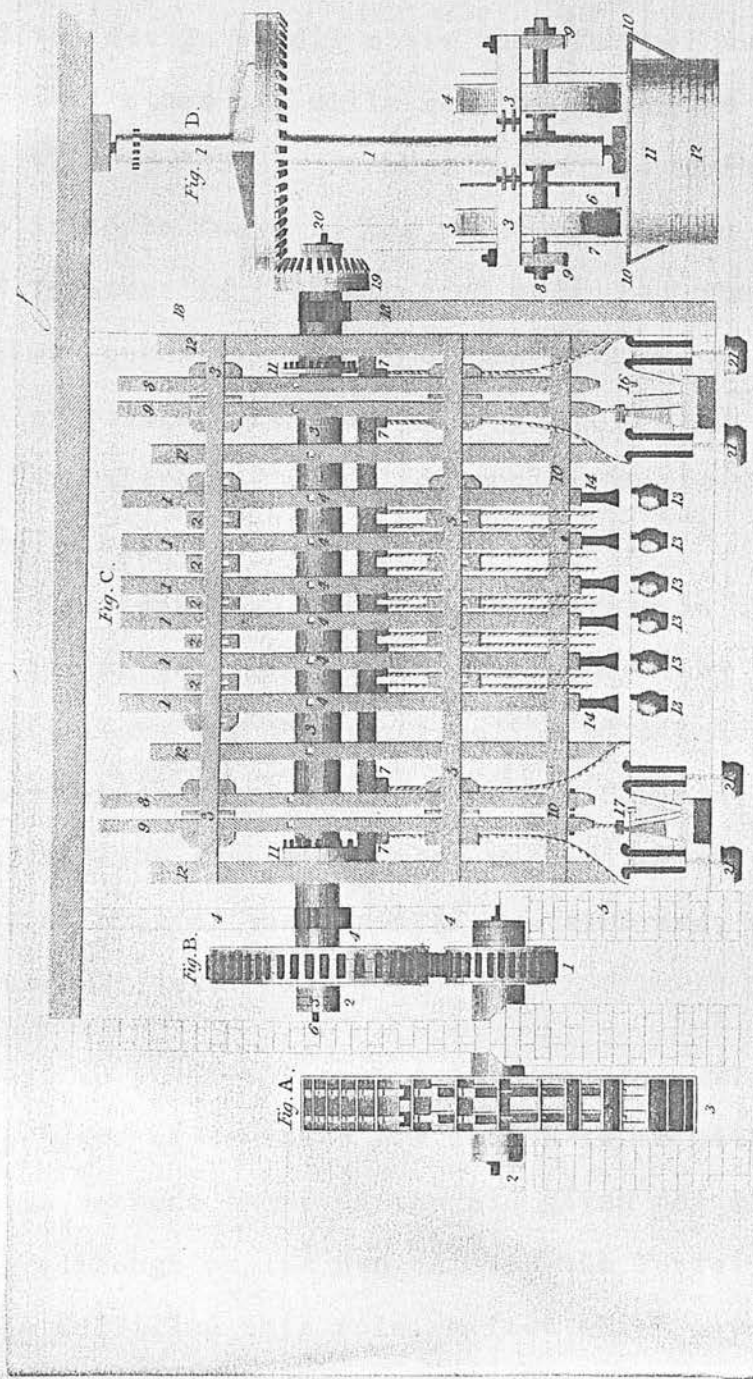
The mill was to be built in stone, fifty feet by twenty-two feet, with a slate roof. Inside, the mill had a ground floor and two separate lofts. From an external wheel, via an axletree, two more axletrees, one horizontal and one vertical, drove the oil press and stampers respectively. The latter were probably used to break up the seeds prior to pressing. As for the press itself, it consisted of one horizontal stone six feet in diameter by ten inches thick, upon which revolved two vertical stones, six feet in diameter by fourteen inches thick, which crushed the seed in their circular path. The whole press was enclosed in iron supplied from Carron,

the same material being used for axletrees. Although this particular mill included stamps it seems probable that some mills had only a set of vertical stones, the initial breaking being performed by hand¹⁷¹.

As far as is known, there were few major technical advances during the period when oil mills operated in Scotland. In 1766 John Craig at Linlithgow Bridge claimed to have made improvements in oil mill design and was asked by the Board of Trustees for a model and estimates for a full-sized mill¹⁷². Nothing is known of the nature of these improvements nor of the fate of Craig's design. In 1805 David MacVicar and George Sandeman in Perth asked the Board for encouragement to build a mill to crush lint seed oil in return for which they offered to send a person to England to look for improvements. The Board appears to have found the application rather vague and no more is heard of the proposed mill¹⁷³. Figure 15.20 illustrates the machinery of an oil mill c. 1810.

The Mills on the Ground

In the "Scots Courant" for 14th August 1719, the Duke of Atholl advertised that he had had much success in growing not only lint seed but rape seed and offering enough for one acre to anyone who would try it. As a further incentive and a means of reaping some benefit himself, he offered £20 Sterling for each boll of Scottish grown seed sent to the "Oyl Mill of Huntingtower" before Michaelmas 1720¹⁷⁴. This is the earliest reference to a Scottish oil mill. No other sites have been positively



identified prior to the 1760's although it is probable that others had been built by then: the suggestion, in 1730, that oil-crushing machinery be modified to dress flax at Bonnington Mills indicates that the technology was already fairly well-known¹⁷⁵. Craig's claim to have improved the design of oil mills adds further support to the view that other oil mills were operating in Scotland prior to 1766 (p.280). Perhaps the most conclusive evidence is to be found in the premiums offered by the Board of Trustees in 1771 for seed producers who sent the greatest quantity of seed to the mill.

Although proposals were made in 1767 for a mill at Culcrieff, Perthshire and detailed specifications were drawn up, it would appear that it was never built¹⁷⁶. However, there were at least two oil mills operating in Strathearn by 1775, one at Crieff the other near Abernethy¹⁷⁷. The next twenty years saw the construction of a dozen or so others, and while these included one at Gourock, Renfrewshire, by far the greatest number were situated in the flax growing area of east Central Scotland and, notably, in Strathearn (figure 15.21).

In contrast to their activities in connection with lint mills the Board of Trustees had little to do with oil mills. No records exist of the aid given for mill building, although on its own estates the Forfeited Estates Commission fulfilled this role, a fact which may account for the concentration of oil mills in western Strathearn on their Perth estate. There is only one reference to the Board of Trustees offering an incentive to growers,



in 1771, when premiums totalling £35 were offered to seven persons who sent the greatest quantity of flax seed of their own raising to oil mills¹⁷⁸.

With this one exception the only aspect of oil milling to attract their attention was the nature of the seed used, for there was a real danger of the bad seed reserved for milling finding its way onto the market as sowing seed. In 1781 a complaint was made to the Board concerning the sale of bad seed, the proprietors of Balbirnie Mill being singled out for blame¹⁷⁹. By 1799, with this type of abuse in mind, the Board of Trustees had imposed a ban on the import of bad seed for milling¹⁸⁰. In 1800 the legislation was modified so as to allow the importation of bad seed on condition that security was given but this was revoked in 1804, possibly as a result of abuses¹⁸¹.

Persistent complaints by oil millers failed to move the Board, although they occasionally gave tacit approval to the import of bad seed. According to the millers, most of their mills were built at a time when seed could be imported freely and as a result of the ban they were frequently at a standstill. At a time when domestic flax cultivation was in decline the hardship must have been all the greater. The mill owners also contrasted the situation in Scotland with that in England and Ireland where there were no restrictions on the importation of crushing seed¹⁸².

Finally, in 1810, the Board gave way and agreed to allow importation for a trial period¹⁸³. While no details are available as to the length of the trial in all probability

the ban was dropped, for by the 1830's a mill had been built at Port Seton, East Lothian, in a situation where it could only have used imported seed¹⁸⁴.

Mill Builders

Like lint mills, oil mills were often built on the initiative of farmers and landowners but there was also a strong mercantile element more commonly found in the other sectors of the linen industry. This may reflect the heavier financial commitment which, in the absence of aid from the Board of Trustees, was necessary to build an oil mill. It may also be a reflection of the need for marketing facilities.

As has already been stated (p. 280) Scotland's first oil mill was built by the Duke of Atholl, a well-known Improving landowner. By the 1770's and 1780's, however, the initiative had passed to other groups. It was a merchant, Patrick Arnot, who built the mill at Crieff in 1774¹⁸⁵, while the Struthill Mill (1780) was a joint venture involving a farmer and a merchant (p. 284)¹⁸⁶. The rival mill, at Milnab (1780), involved three partners including James Wright, smith and farrier in Crieff¹⁸⁷. The mill at Gartchonzie, near Callander, was one of two mills operated by Arthur Buchanan, a tenant farmer¹⁸⁸. At the same time and in a similar manner to lint mills the interest of landowners which had been apparent in the founding of the first mills continued throughout the 18th century¹⁸⁹.

Two Scottish Oil Mills:

Mill of Struthill and Milnab, Perthshire

The development of the Scottish oil mill is probably best exemplified by two mills in Strathearn, the Mill of Struthill and Milnab. Both date from 1780, during the period which saw the construction of most Scottish mills and both are well documented in the records of the Forfeited Estates Commission.

On 14th November 1780 Patrick Davidson in Drummawhance and Matthew Finlayson, merchant in Muthill, petitioned the Forfeited Estates Commission, pointing out that local flax-raising had increased greatly and that farmers were taking the trouble of saving their lint seed. The petitioners went on to propose that they be given a forty-one-year lease, timber and other aid, in return for which they would convert the Mill of Struthill to crush lint seed¹⁹⁰. As the mill was one of four corn mills within a few miles of each other, the tenant was finding it hard to pay for the upkeep of the mill and was all too glad to resign his tack in their favour¹⁹¹. The Commission's factor added his approval to the venture, pointing out that in the previous year Patrick Arnot's mill at Crieff had had more seed than it could handle¹⁹².

The very next day the Commission was sent another petition, this time from James Wright, smith and farrier in Crieff, proposing to build an oil mill below the Nether Mill of Milnab in Crieff parish. Objections were raised on the grounds that it would flood good land, while the factor, Thomas Keir, advised against the "encouragement" of two

oil mills at the same time. In his opinion the Mill of Struthill was a more deserving project¹⁹³. Undeterred by this rebuff Wright wrote to the Commissioners pointing out that the Mill of Struthill was "in a wilderness", a long way from anywhere and with only enough water to work for eight hours per day¹⁹⁴.

In the meantime the promoters of Struthill Mill had drawn up detailed specifications and costings (p.279 and Appendix I) and had asked the Commission for blown or dead ash, plane, beech or oak from which to make machinery¹⁹⁵. In the absence of any evidence to the contrary it would appear that the mill received financial help from the Commission.

At Milnab, on the other hand, no financial aid was given although the Commission supplied some timber from Drummond Park for heavy machinery¹⁹⁶. It was perhaps with a view to acquiring additional capital that Wright joined with two others, John Cook and Thomas Caw; together they set about implementing an enlarged plan to include not only an oil mill but also a paper mill (cf. Chapter 22 p. 525)¹⁹⁷. Caw dropped out of the partnership at an early stage but Wright and Cook succeeded in obtaining from the Commissioners a forty-one-year tack of land at Milnab, at three guineas per annum. By 1782 the mill had been completed at a cost to the partners of nearly £400¹⁹⁸.

A report on the Perth Estate, compiled in 1783 by William Frend, gives some indication of the relative fortunes of the two mills. The Mill of Struthill had been sub-let to one Robert Sorley at a very high rent. Like the last

tenant of the corn mill Sorley was unable to pay for the upkeep of the mill with the inevitable result that it had "gone to ruin entirely", putting local lint seed growers to some inconvenience. Paradoxically Frend recommended that the mill be converted to grind meal. In contrast, the mill at Milnab was in good order and "likely to answer well". The paper mill, which had not answered so well, was to be converted to a flour mill¹⁹⁹. Both mills continued to operate until the 1790's by which time Milnab was pressing three to four hundred bolls per annum, the locally-grown lintseed being purchased at 18s per boll²⁰⁰. No details are available for the Mill of Struthill²⁰¹. By 1860, when the first Ordnance Survey maps were surveyed, the Mill of Struthill had disappeared off the face of the earth but Milnab was one of only two oil mills still operating in Scotland. Obviously Wright's faith in his site had been well-founded.

The Fate of the Mills

While the period 1775 - 1795 appears to have been a Golden Age for Scottish oil mills the early years of the nineteenth century seem to have brought an abrupt end to it. Those mills which had depended on home-grown seed must have suffered badly from the decline of domestic flax cultivation, while those using imported seed were hampered, at least temporarily, by import restrictions. Furthermore, the competition from England and Ireland, of which the petitioners had spoken in 1810, may have finally proved to be too much for Scottish oil millers. The mill on the Dichty near Dundee, which in the 1790's had been

crushing eight hundred bolls of lint seed per annum and exporting oil to London at 1s 3d per pint, closed down shortly afterwards²⁰². The oil mill at Bridge of Balgonie, Fife, had gone out of production by 1830²⁰³ and by 1860 one mill in Auchterarder parish, Perthshire, had been converted to grind farina or potato flour²⁰⁴. Many others, including Gartchonzie and the mill in Abernethy parish, had ceased to exist. As with flax scutching mills, time had run out for Scottish oil mills.

to refill and amend a machine for flax dressing, set up by him some years ago on the Water of Leader.

Brown, R., "The History of Paisley" 2 vols. Paisley 1886. I. 296

SRQ NG1/1/3 20/7/1733. Petition from the town of Paisley - set up lint mill several years ago for 3,000 Marks. Now in disrepair. Hear that there is a better way.

SRQ NG1/1/1 1/8/1737

SRQ NG1/1/2 13/9/29

SRQ NG1/1/3 12/12/38

SRQ NG1/1/1 26/8/1738

SRQ NG1/1/1 18/7/29

SRQ NG1/1/1 28/11/1739

SRQ NG1/1/2 10/3/40

SRQ NG1/1/2 21/11/1739

SRQ NG1/1/4 10/1/45

SRQ NG1/1/6 25/4/40

SRQ NG1/1/8 7/11/46; 18/3/47 One of the machines

mentioned at the 1747 meeting as being designed by James

Hog was the subject of a report by the millers in 1754.

The Minute books give no details

- 1 : Robertson, J. "General View of the Agriculture of Inverness-shire" London, 1808 151
- 2 : Singer, C., Holmyard, E.J., Hall, A.R., Williams, T.I. (Eds) "A History of Technology" 5 vols. Oxford 1956-9 III 157
- 3 : McCutcheon, W.A., "Water Power in the North of Ireland" in TNS XXXIX (1966-7) 73
- 4 : SRO NG1/1/2 Patterson of Drygrange asks encouragement to refit and amend a machine for flax dressing, set up by him some years ago on the Water of Leader.
Brown, R., "The History of Paisley" 2 vols. Paisley 1886 I 398
SRO NG1/1/3 20/7/1733. Petition from the town of Paisley - set up lint mill several years ago for 3,000 Merks. Now in disrepair, Hear that there is a better way.
- 5 : SRO NG1/1/1 1/9/1727
- 6 : SRO NG1/1/2 19/9/29
SRO NG 1/1/2 12/12/29
- 7 : SRO NG1/1/1 26/4/1728
- 8 : SRO NG1/1/1 18/7/29
- 9 : SRO NG1/1/2 28/11/1729
- 10 : SRO NG1/1/2 10/3/30
- 11 : SRO NG1/1/2 27/11/1730
- 12 : SRO NG1/1/4 10/1/35
- 13 : SRO NG1/1/6 25/4/40
- 14 : SRO NG1/1/8 7/11/46; 18/3/47 One of the machines mentioned at the 1747 meeting as being designed by James Hog was the subject of a report by the Meikles in 1754. The Minute books give no details

- 14 : SRO NG1/1/13 4/11/55
- 15 : SRO NG1/1/8 12/6/47
- 16 : SRO NG1/1/22 13/1/79; 3/2/79
- 17 : SRO NG1/1/11 18/1/51; 22/2/51; 3/1/52
- 18 : SRO NG1/1/11 7/6/51
- 19 : Hamilton, H. (Ed) "Life and Labour on an Aberdeenshire Estate 1735-1750" Aberdeen 1946
- 20 : Stewart, A. "A Highland Parish or the History of Fortingall" Glasgow 1928 173
- 21 : Hamilton, op.cit., 146-7
- 22 : SRO NG1/19/1 Reports Anent Lint Mills
McCutcheon, op.cit., 73-5
- 23 : SRO NG1/1/20 24/11/73 For an estimate of the cost
of such a mill se SRO GD248/954/1
- 24 : SRO NG1/19/1 Edinburgh 2
- 25 : SRO NG1/1/16 22/1/62
- 26 : SRO NG1/1/16 21/1/61; 22/1/62; SRO NG1/1/19 12/3/68
- 27 : SRO NG1/1/17 15/8/63
- 28 : Home, Henry (Lord Kaimes) "Progress of Flax Husbandry in Scotland" Edinburgh 1766 23
- 29 : SRO NG1/1/18 12/3/64
- 30 : SRO NG1/1/18 20/1/66
SRO NG1/19/1 Lanarkshire 7
- 31 : SRO NG1/1/18 27/11/66; 24/3/67; 4/3/68
- 32 : SRO NG1/19/1 Lanarkshire
SRO NG1/1/19 26/7/68; 13/8/68
- 33 : SRO NG1/1/19 12/2/70; 29/1/72
SRO NG1/19/1 Lanarkshire 10
- 34 : SRO NG1/1/20 28/7/73

- 35 : SRO NG1/1/20 15/12/73
SRO NG1/1/22 5/8/78
SRO NG1/1/23 31/1/82
SRO NG1/1/24 16/6/84; 30/6/84
SRO NG1/1/25 9/8/86; 29/6/85
- 36 : SRO NG1/1/25 28/11/85
- 37 : SRO NG1/1/16 21/1/61.
SRO NG1/1/29 28/6/97
- 38 : SRO NG1/1/25 12/12/85
- 39 : SRO NG1/1/27 24/2/90
SRO NG1/1/28 26/11/94
- 40 : SRO NG1/1/33 22/1/17
- 41 : SRO NG1/1/33 22/11/15; 6/3/16
- 42 : Warden, A.J. "The Linen Trade, Ancient and Modern"
London 1864 30
- 43 : SRO NG1/1/2 17th July 1730
- 44 : SRO NG1/1/3 8/2/34
- 45 : SRO NG1/1/4 7/11/35; 29/10/36; 5/8/37
- 46 : SRO NG1/1/4 23/7/36; 3/12/36; 24/2/38
SRO NG1/1/5 1/2/40
- 47 : SRO NG1/1/12 19/1/53
- 48 : SRO NG1/1/17 23/7/62
- 49 : SRO NG1/1/4 5/8/37; 13/1/38
- 50 : SRO NG1/1/4 5/8/37
SRO NG1/1/5 19/1/39; 22/2/40
- 51 : SRO NG1/1/6 11/3/41
- 52 : SRO NG1/1/7 7/3/44
- 53 : SRO NG1/1/7 1/3/45
SRO NG1/1/8 4/7/46; 23/1/47
SRO NG1/1/9 18/1/48; 18/1/49

- 54 : SRO NG1/1/9 3/2/49
SRO NG1/1/10 12/1/50
- 55 : SRO NG1/1/10 2/2/50
SRO NG1/1/11 18/1/51; 3/1/52
SRO NG1/1/12 19/1/53
- 56 : SRO NG1/1/12 13/12/54
- 57 : SRO NG1/1/14 15/12/58
- 58 : SRO NG1/1/14 15/12/58
SRO NG1/1/16 22/1/62
SRO NG1/1/17 27/4/63
- 59 : SRO NG1/1/7 28th December 1744
- 60 : Home, op.cit., 12
- 61 : SRO GD248/954/1 Description of a Lint Boor. Edinburgh
17th July 1747 12
- 62 : Home, op.cit., 12
- 63 : SRO NG1/1/7 3/4/45; 5/7/45
- 64 : SRO NG1/1/7 12/7/45
- 65 : SRO NG1/1/8 12/6/47; 17/7/47
- 66 : SRO NG1/1/9 11/1/48
- 67 : SRO NG1/1/9 18/1/49
- 68 : SRO NG1/1/10 12/1/50
- 69 : SRO NG1/1/10 23/6/49
- 70 : SRO NG1/1/10 7/3/50
- 71 : SRO NG1/1/11 16/11/50
- 72 : SRO NG1/1/10 9/6/49
- 73 : SRO NG1/2/5 11/2/52
- 74 : Durie, A.J. "The Scottish Linen Industry 1767-1775
with particular Reference to the Early History of
the British Linen Company" PhD Thesis Edinburgh 1973 103
- 75 : SRO NG1/1/19 4/12/71 SRO NG1/1/20 10/2/73

- 76 : SRO NG1/1/20 28/7/73
- 77 : SRO NG1/1/16 22/1/62
- 78 : SRO NG1/1/17 27/4/63
- 79 : SRO NG1/1/20 10/2/73
SRO NG1/1/25 19/12/85
- 80 : SRO NG1/1/25 19/12/85
SRO NG1/1/28 15/1/94
SRO NG1/1/32 9/7/06
- 81 : SRO NG1/1/18 18/3/65
SRO NG1/1/26 30/7/88
- 82 : For references to other mills taking apprentices see
SRO NG1/1/27 30/1/91; 25/5/91; 18/8/89
SRO NG1/1/25 23/1/86
SRO NG1/1/26 5/3/88
SRO NG1/1/28 8/2/92; 13/11/93; 18/12/93
SRO NG1/1/29 9/12/95; 20/1/96
SRO NG1/1/30 12/6/99; 25/6/09
SRO NG1/1/31 21/11/04; 27/2/05
SRO NG1/1/32 9/7/06; 2/11/10; 5/6/11
SRO NG1/1/33 29/1/12; 23/11/14; 5/3/17
SRO NG1/1/34 13/3/19
- 83 : SRO NG1/1/20 17/3/73
- 84 : SRO NG1/1/6 6/2/41
- 85 : SRO NG1/1/11 21/6/51
- 86 : NLS Acc 2933/330 Petition Alexander Morison et al
Forgue parish, Aberdeenshire 1762
SRO NG1/1/17 27/4/63
- 87 : SRO NG1/19/1
- 88 : SRO NG1/1/23 14/2/81
- 89 : SRO E 777/198/14 20/11/64

- 90 : For work to date on lint mill numbers see Hamilton
H. "An Economic History of Scotland in the Eighteenth
Century" Oxford 1963 135
McClain, N.E. "Scottish Lintmills, 1729-70" in
Textile History, I, 3/12/70 293-308
Durie, A.J. "The Scottish Linen Industry" Edinburgh 1978
- 91 : SRO NG1/1/1-36
- 92 : SRO NG1/1/19
- 93 : Hamilton, op.cit., (1963) 135
- 94 : Although not listed in the 1772 survey, Hospital Mill
was known to be working in 1751 and 1774:
SRO NG1/1/11 22/2/51; SRO NG1/1/21 30/11/74
- 95 : SRO NG1/1/19 Dunbartonshire 4 / Lanarkshire 26
Forfarshire 22 / Perthshire 27
- 96 : SRO NG1/1/23 6/8/83
- 97 : Bonnington Mill SRO NG1/1/2 10/3/30
Colinton Mill SRO NG1/1/8 12/3/47
Bute Mill SRO NG1/1/16 22/1/62
- 98 : SRO NG1/1/2 17/7/1730; 23/2/1731
- 99 : SRO NG1/1/4 21/2/35
SBRS "Extracts from the Records of the Burgh of Glasgow"
V (1718-38) Glasgow 1909 434
- 100 : SRO NG1/1/3 20/7/33; 24/8/33
- 101 : SRO NG1/1/11 13/7/50
SRO NG1/1/10 8/6/50
Hamilton op.cit., (1946)
- 102 : SRO NG1/1/10 22/6/50
SRO NG1/1/11 21/6/51
- 103 : See for example Petition of Robert Gordon, tacksman of
Cairnie Mill, Perthshire: SRO NG1/1/21 21/2/76

- 104 : See for example Quartalehouse: SRO NG1/19/1 Aberdeenshire 4
Moulin: SRO NG1/19/1 Perthshire 67
- 105 : See for example SRO NG1/19/1 Stirlingshire 12-13
Perthshire 16
Elgin 2
- 106 : Joiner: SRO NG1/1/27 23/6/90
Mason and Wright: SRO NG1/1/25 11/12/86
Millwright: SRO NG1/1/27 2/12/89
Minister: SRO NG1/1/27 20/1/90
Advocate: SRO NG1/1/25 19/12/85
- 107 : Grant of Grant: SRO NG1/1/28 8/2/92
Duke of Gordon: SRO NG1/1/26 20/2/82
Sinclair of Ulbster: SRO NG1/1/26 23/7/88
- 108 : British Linen Company: NLS Acc 2933/350 1/1/1749
N.E. Scotland: OSA XIII 425 Gollactrie, Aberdeenshire
SRO NG1/1/18 19/2/68 Huntly, Aberdeenshire
SRO NG1/1/28 22/5/93 Letham, Angus
SRO NG1/19/1 Banffshire 8 Cullen
SRO NG1/1/16 22/1/62 Drum, Banffshire
SRO NG1/1/10 9/6/49 Linkwood, Moray
- 109 : McClain, op.cit., 294
- 110 : SRO NG1/1/12 19/1/53
- 111 : SRO NG1/1/17 15/8/63
- 112 : SRO NG1/1/28 19/12/92 According to Alex. Munro,
stampmaster in Glasgow, linen had fallen so much in
favour of cotton that he could hardly pay his office rent.
- 113 : McClain, op.cit., 307-8
- 114 : Thomson, J. "General View of the Agriculture of the
County of Fife" Edinburgh 1800 206-7 208

115 : See Handley, J.E. "The Agricultural Revolution in Scotland" Glasgow 1963

116 : SRO NG1/1/33 8/3/15

117 : NSA Aberdeenshire, 158, 305, 419, 442, 572, 982

Ayrshire 508

Banffshire 138, 164, 238, 341, 390

Dumfriesshire 184

Dunbartonshire 199

Fife 227, 385

Forfarshire 333

Kirkcudbrightshire 43, 288

Lanarkshire 401

Perthshire 293, 407, 505, 1012

Stirlingshire 118, 214, 385

West Lothian 51

Wigtownshire 74

118 : NSA Ayrshire 508

119 : SRO NG1/1/11 13/7/50

120 : SRO NG1/2/5 22/7/52

121 : SRO NG1/2/4 12/1/50

122 : SRO NG1/1/11 22/5/51

123 : SRO NG1/2/4 24/7/50

124 : SRO NG1/2/4 22/3/51

125 : SRO NG1/2/4 22/6/50

126 : SRO NG1/1/11 18/1/51

127 : SRO NG1/1/11 22/5/51

128 : SRO NG1/2/4 5/3/51; 7/6/51

129 : East Lothian's first turnpike Act was passed in 1749

130 : SRO GD6/1275

131 : SRO NG1/1/12 19/1/53; 14/12/53; 13/12/54

- 132 : SRO GD6/1275 Agreement, Lord Belhaven and Thomas
Finlayson, 1754
- 133 : SRO NG1/1/14 15/12/58
- 134 : SRO NG1/1/14 15/12/58
SRO NG1/1/17 27/4/63
- 135 : SRO NG1/19/1 Haddingtonshire 1
- 136 : Ibid.
- 137 : SRO NG1/1/20 10/2/73
- 138 : SRO NG1/1/20 3/3/73
- 139 : SRO NG1/1/20 28/7/73
- 140 : SRO NG1/1/22 21/1/78
- 141 : Ibid.
- 142 : SRO NG1/1/22 18/2/78
- 143 : SRO NG1/1/22 13/1/79
- 144 : SRO NG1/1/23 4/7/81; 1/8/81
- 145 : SRO NG1/1/25 19/12/85
SRO NG1/1/28 15/1/94
- 146 : SRO NG1/1/32 9/7/06
- 147 : SRO NG1/1/27 2/3/91; 9/3/91
SRO NG1/1/32 9/7/06
- 148 : Fowler, Greenwood & Sharp, (Map of) Haddingtonshire
1825. The lint mill is shown as in use.
On the first Ordnance Survey map of East Lothian
(surveyed 1853), the mill is shown as disused.
- 149 : An early 19th century estate plan, in the possession
of Mr. E. Jeffrey, Biel Grange, shows a lade running
past the by then disused mill to water wheels on Biel
Grange and Beesknowe farms.
- 150 : Naismith, J. "Thoughts on the Various Objects of Industry
pursued in Scotland" Edinburgh 1790 219

- 151 : Ibid., 230
- 152 : Home, op.cit., 6
- 153 : Ibid., 15
- 154 : Naismith, op.cit., 220
- 155 : SRO NG1/19/1 Fife 9
SRO NG1/19/1 Aberdeenshire 4
- 156 : McClain, op.cit., 301
- 157 : SRO NG1/1/16 22/1/62
SRO NG1/19/1 Banffshire 8
- 158 : SRO NG1/1/19 23/12/68
- 159 : Home, op.cit., 15-16
- 160 : Naismith, op.cit., 219
- 161 : Ibid., 219
- 162 : Ibid., 221
- 163 : Ibid., 221
- 164 : Home, op.cit., 16
- 165 : McClain, op.cit., 303
- 166 : Naismith, op.cit., 222
- 167 : McClain, op.cit., 303-4
Home, op.cit., 15
- 168 : McClain, op.cit., 199-302
- 169 : Ibid., 303
- 170 : OSA XXI 53
Singer, C., Holmyard, E.J., Hall, A.R. and Williams,
T.I. (Eds) op.cit., III 697
- 171 : SRO E777/198/62
- 172 : SRO NG1/1/18 21/11/66
- 173 : SRO NG1/1/31 26/6/05
- 174 : Murray, D. "The York Buildings Company. A Chapter in
Scotch History" Glasgow 1883 39

- 175 : SRO NG1/3/2 6/2/35
- 176 : SRO E 777/129/4 13/7/67
- 204 SRO E 777/198/27 5th Mile, 1985 Paritoshura
- 177 : SRO E 777/198/38
- Ainslie, J., Fife 1775 (Map)
- 178 : SRO NG1/1/18 21/11/66
- 179 : SRO NG1/1/23 4/7/81
- 180 : SRO NG1/1/30 23/11/99
- 181 : SRO NG1/1/32 4/2/07
- 182 : SRO NG1/1/32 30/11/08; 8/2/09; 4/7/10
- 183 : SRO NG1/1/32 4/7/10
- 184 : NSA II 298
- 185 : SRO E 777/198/38
- OSA IX 583
- 186 : SRO E 777/198/53 (1) 14/11/80
- 187 : SRO E 777/198/55; E 777/198/58
- 188 : SRO E 777/198/44; E 777/129/6; E 777/198/51
- 189 : See for example OSA IX 94
- 190 : SRO E 777/198/53
- 191 : SRO E 777/198/53
- 192 : SRO E 777/198/53
- 193 : SRO E 777/198/55
- 194 : SRO E 777/129/8
- 195 : SRO E 777/198/53; E 777/129/7
- 196 : SRO E 777/198/58
- 197 : Ibid.
- 198 : SRO E 777/198/62
- 199 : SRO E 777/252
- 200 : OSA IX 583
- 201 : OSA VLII 485

202 : OSA XIII 493

203 : SRO R.H.P. 770

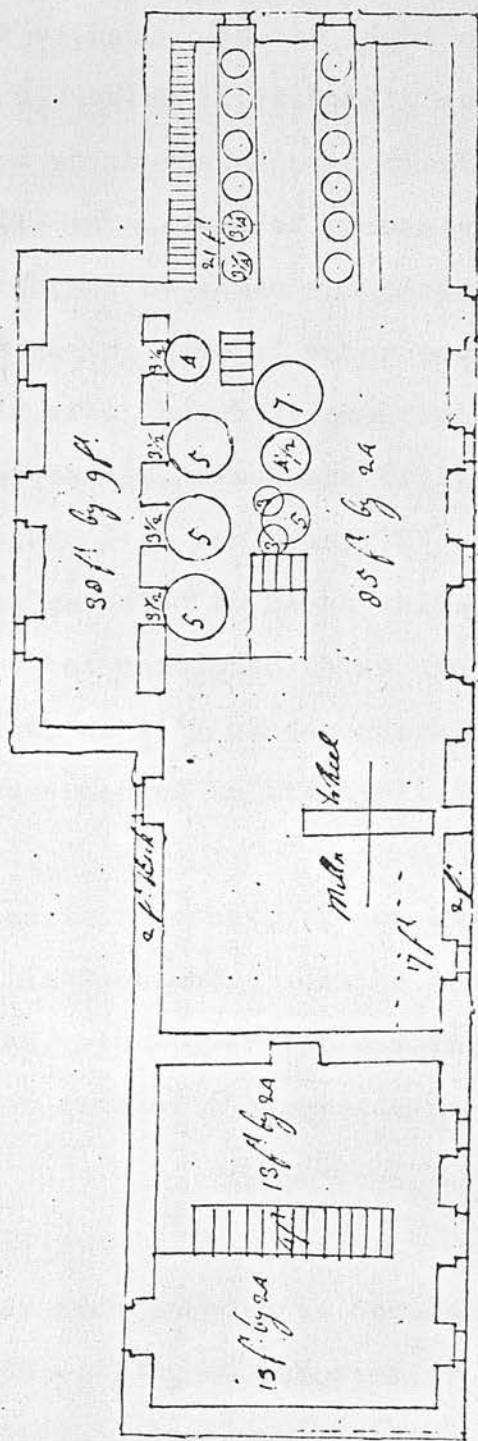
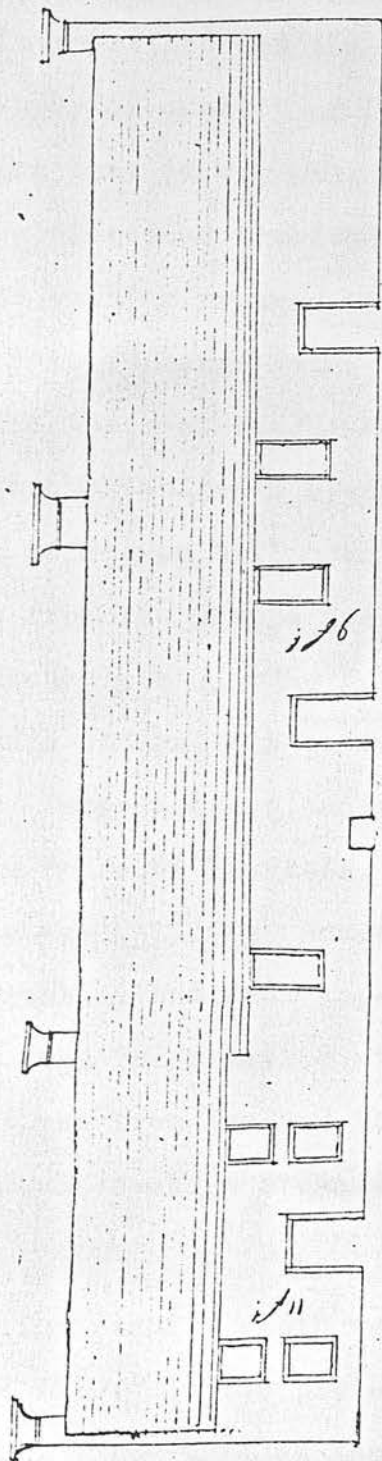
204 : O.S. 1st Edition 6"/mile, 1861 Perthshire

BLEACHFIELDS

As early as the 16th century the manufacture of coarse linen cloth had become an industry of some consequence in Scotland¹. However, so primitive were the methods employed that the Scottish product was totally unable to compete with the vastly superior linen cloth of Holland and Germany, from whom Scotland and her more prosperous neighbour, England, continued to import all but the poorest cloth. One major factor was the inferiority of Scottish bleaching: for the most part it was carried out manually by private individuals on the banks of streams or in meadows and while a handful of bleachfields, such as that at Corstorphine, were set up before 1728, it was only after that date that attention began to be focused on the technology of bleaching as a means of improving the finished product.

TechnologyThe Bleaching Process: Dutch and Irish Methods

The bleaching process as practised in 18th century Scotland consisted of boiling and soaking in alkali, wringing or mangling, then soaking in acid. This was followed by a second washing, drying and finishing either by beating or pressing². Banks of boilers or "keivs" and tubs for washing can be seen in a plan of Deskford bleachfield, c.1752 (figure 16.1). While these differed only in scale from the primitive coppers used by private individuals, the other processes in bleaching saw considerable mechanisation, much of which involved the introduction of



water-powered machinery.

In Scotland two distinct methods were used in bleaching: the Irish method and the Dutch method. In the light of the superior quality of Dutch bleaching it is hardly surprising that it was this method which was adopted first. The Dutch method involved little in the way of mechanisation as the washing process was performed by women who cleaned the cloth in large vats, no use being made of water power. Perhaps the most famous example of a "Dutch" bleachfield was that established by two merchants, Andrew and William Gray, at Provan Mill near Glasgow. As early as 1728 cloth from the Gray's field was reported to be as white as Dutch cloth³. The Dutch method continued to be used for much of the 18th century and, as will be demonstrated later, large sums of money were expended in its application by the Board of Trustees. By the early 1730's, however, another process, known as the Irish method, had appeared in Scotland. Unlike the Dutch, the Irish method utilised water-power for washing and it was from Ireland too that many of the subsequent technical advances stemmed.

Washing Mills

Mills for washing cloth were far from unknown in Scotland before 1730: in the period 1550 - 1730, at one time or another, there were at least three hundred waulk mills for washing or fulling cloth (cf. Chapter 3 p. 53) and it seems likely that Scotland was one of the sources from which fulling mills were introduced into Ireland during the 17th century⁴. It is, therefore, somewhat

paradoxical to find them being re-introduced into Scotland from Ireland in the following century as "putstock" mills or under the Irish name of "tuke miln".

The earliest reference to the use of the Irish method in Scotland is to a field at Ormiston, East Lothian, which one Alexander Christie was said to have founded in 1731⁵. By 1734 it was being run by John Christie and John Drumond⁶. According to the Board's committee "their bleaching house is large, and the coppers, keeves, pumps, tubs and tuke miln of very good workmanship"⁷. In the same year, a bleachfield established by Richard Holden at Baldovie, near Dundee, had "two mills for beating and cleansing the cloth", while in 1755 the same Alexander Christie who had founded Ormiston bleachfield had entered into an eighty-year tack, from the Earl of Kinoul for land at Tulloch, near Perth, on which he established a bleachfield with washing mills⁸.

While the comparative gentleness of the Dutch method rendered it suitable for fine cloth, the Irish method was found to be the better one for bleaching the coarse cloth which represented the bulk of Scottish output. Therefore most of the larger Scottish bleachfields of the 18th century were built with washing mills, and gradually the Irish method came into general use. By the 1760's Gray's Green bleachfield, where so much private and public capital had been invested in the 1730's and 1740's, was in such a state that the bleacher had to turn down an offer of help for new capital works "because it would cost more money - which his business will not bear, being

greatly declined since the Irish method of bleaching prevailed, and he has no water for machinery in the Irish way"⁹.

Rubbing Mills

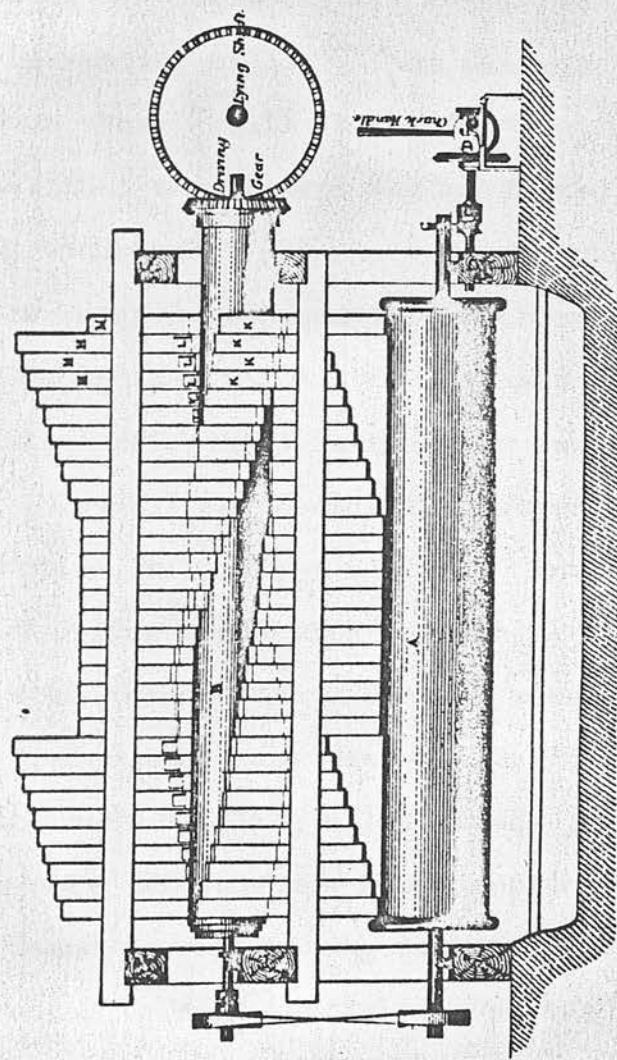
The next process to be mechanised was rubbing. The usual arrangement was to have two square boards, toothed transversely, the upper of which moved by a crank and driven by water-power, passed over the unpowered lower board in a rubbing action¹⁰. According to McCutcheon¹¹ the process had been mechanised in Ireland by about 1740, although Gauldie gives a date some ten years earlier¹². While the "Irish rubbing mill", operated by two men, could do as much work in one day as could twenty women by hand, it was found to give a woolly surface to the cloth, which soon dirtied, and for that reason rubbing by hand continued to be employed for the finer fabrics¹³.

Although there are few substantiated reports of rubbing mills in Scotland before the late 1740's, it would seem that, for the coarser fabrics at least, they had become a common feature by mid-century and that the ingenuity of Scottish millwrights had been applied to making further refinements. It is not surprising to find the names of Robert and Andrew Meikle associated with these: in 1754 they claimed to have devised a means whereby cloth could be drawn through the rubbing mill by machine, an innovation which, having succeeded in its first application, had been copied elsewhere in Scotland and in Ireland¹⁴. In the following year they were presented with a £40 reward from the Board of Trustees¹⁵. It is probable

that most of the subsequent rubbing mills, such as that installed at Cullen in 1762, incorporated this modification¹⁶. While they never became as common as the wash mill, rubbing mills continued to be installed at new and existing bleachfields throughout the 18th century and into the early 19th century; at Cullen in 1802, at Ednam, Roxburghshire, in 1810 and at Coveyheugh, Berwickshire, in 1813¹⁷. In the latter part of the period some of the larger bleachfields had two or more rubbing mills. Ness bleachfield near Inverness had two in 1791, as had Keirfield, Stirlingshire, in 1827¹⁸.

Beetling Mills

That the finished product might have a smooth surface, it was customary to subject it to a pressing. Under the Dutch method the cloth was usually passed between rollers or calenders¹⁹ but at fields where the Irish method was employed the cloth, having passed over a roller, was beaten by hammers or stamps raised and lowered by cams set in a double helix on a rotating shaft (figure 16.2)²⁰. In any one machine there could be perhaps twenty-five stamps and bleached cloth was subjected to this treatment for at least four days²¹. Because of the great amount of effort required beetling mills were usually water- or occasionally horse-powered. According to McCutcheon²² the beetling engine was introduced into Ireland in 1725, but the reference is unsubstantiated and the machine's origin obscure. Certainly the principle employed is the same as that used for some time in the paper industry and in mineral dressing



(pp.515 and pp.572) and it may have been from these applications that the idea stemmed. As for the date of its introduction into Scotland, there is some confusion: Gauldie²³ claims that beetling engines were in use at Pitkerro, Angus, in 1732 and at Ormiston by 1734; the report of a visit to Pitkerro in 1734 mentions two mills for "beating and cleansing the cloth" but these were probably only washing mills²⁴. At Ormiston, in 1734, there was "a room where cloath is beetled" but there is nothing to suggest that the process was performed mechanically²⁵. According to Green²⁶, a Scots engineer named William Bell invented a water-driven beetling machine c. 1745 and introduced it to Ireland. This corresponds with the earliest substantiated references to beetling engines in that country. In 1751 the Board of Trustees paid 40s to George Landale, millwright of Perth, for "a model of a miln for beetling cloth after bleaching", a move which suggests that the machine was still something of a novelty²⁷. Later that same year the Board decided to offer £50 for the best beetling mill fitted up in Scotland during 1752, but only "if upon due consideration beetling cloth shall be found a proper thing to be encouraged"²⁸. The Board intended to seek the opinion of manufacturers but in the event a shortage of funds prevented the scheme from going ahead²⁹. Shortly after references to beetling mills begin to appear. In 1754 William Sandeman paid £102 15s 11³/₄d for a beetling machine at Luncarty³⁰. Saltoun had a beetling machine before 1760, for in that year new equipment was

installed, consisting of "two sets of beetles and beams proportioned to move at the same time and with the same outer wheel, and these beetles made to strike perpendicular or straightways on the cloth, and not aslant as at present"³¹. Robert Meikle was sent to inspect a beetling mill at Perth, possibly that at Luncarty, and on his return he built an improved machine to his own specifications³². In 1761 an additional beetling mill was built at Luncarty, possibly to Meikle's design³³.

The Board of Trustees gave financial aid for beetling engines at Denovan, Stirlingshire, in 1762 and at Cullen, Strathmiglo and Saltoun Barley Mill in 1763. At the last-mentioned field the mill had cost £86 3s 11d³⁴.

Beetling machines were installed at most of the major Scottish bleachfields during the remainder of the 18th century but at some places, such as Letham, Angus, beetling was still being performed by hand in the 1790's³⁵.

The Board of Trustees were still providing grant aid for this purpose as late as 1823, in which year a replacement machine was installed at Dollar bleachfield³⁶.

As with rubbing boards and washing mills, multiple installations became common. In 1826 Keirfield, Stirlingshire, had twelve sets of beetles³⁷; according to Gauldie³⁸ there were no less than one hundred and eight sets of beetles working on the Perthshire Almond during the 19th century.

The mechanisation of beetling led to a substantial reduction in the number of workers required in cloth finishing and the increased productivity which they offered made beetling engines a worthwhile investment for the larger

fields. In 1794 Joseph Read, bleacher at Linlithgow Bridge, received £10 from the Board of Trustees for designing an improved beetling mill³⁹. In the following year a full-scale machine was set up with three rollers instead of the customary two and "movements for fitting on and changing the cloth from one beam to the other". In the opinion of the Board's inspector the design was "certainly new" and showed "very considerable ingenuity". Its greatest advantage was that it could be operated by one man instead of the three previously required and such was the Board's approval that it offered twenty guineas to those who proposed to adopt it and a further six guineas royalty to Read for each of the first six machines installed⁴⁰.

Read's machine was suitable only for beetling cloth and when, after 1810, coarse linens began to be bleached as yarn rather than as cloth, a modified version of the older type of beetling machine, with a fixed beam, was used⁴¹. A claim to further improvements was made by a Dumfriesshire man, William Steel, in 1821, but no details are available⁴². While other improvements were made later in the 19th century they lie outwith the scope of the present chapter and will be dealt with at a later stage.

Other Applications of Water-Power

In some cases callendering was performed by water-power: a callender was planned for Saltoun bleachfield in 1760, to be driven by the same water wheel as the beetles⁴³. Towards the end of the 18th century large scale mechani-

calenders became widespread. The first powered calender in the Dundee area was installed at Douglasfield in 1797 by William Sandeman. This was also the first application of steam-power to the process. As this source of power developed, particularly in the Dundee area, calendering premises were often set up away from bleachfields in towns⁴⁴.

At Ness bleachfield water-power was used to drive the pumps which supplied the wash mills with water and, while there is no firm evidence, it is probable that water-power was applied to the same purpose elsewhere⁴⁵. At one new bleachfield in Renfrewshire water-power was used to grind ashes⁴⁶. A detailed description of machinery, buildings and fields at Ness bleachfield, Inverness-shire, appears in Appendix J.

Despite the radical changes in the chemistry of bleaching⁴⁷ the industry's mechanical technology, once introduced, changed very little and the heavy, cumbersome machinery which typified the bleachfield of the 18th century continued to be used into the 19th century and even the 20th.

The Workforce

As with lint mills, so also with bleachfields did the Board of Trustees provide facilities for the training of a skilled workforce.

Linen bleaching was already well-established, if poorly executed in Scotland and in the early years of the Board's existence many of the new bleachfields were in the capable hands of the Irish bleachers such as Alexander Christie⁴⁸

or John Christie⁴⁹. Nevertheless, most bleachers were loathe to divulge their secrets and, initially at least, the Board of Trustees took a keener interest in bleaching by the Dutch method than by the Irish, for there had been no influx of Dutch bleachers comparable to that of the Irish.

Gray's Green 1728 - 1748

Prior to the establishment of the Board of Trustees a linen bleachfield had been laid out at Provan Mill, near Glasgow, by two merchants, William and Andrew Gray⁵⁰. One of these two brothers had "been throw (sic) the different parts of Europe where the manufacture is brought to the greatest perfection"⁵¹. By November 1728 linen cloth from the Gray's field was reported to be "fully as whitened (sic) as dutch cloath (sic)"⁵². In 1729 the Grays received a £350 premium from the Board of Trustees, and in 1738 a massive £1,000 to complete their field⁵³ (cf. p 330). By the time the Board had become fully aware of the shortcomings of the first group of bleachfields to be built and financial aid had been withdrawn until such time as techniques were improved⁵⁴. It was against such a background that the Board established its first training scheme, under the auspices of the brothers Gray, at Provan Mill. As only the Dutch method was taught, the Grays Green training scheme is not directly relevant to the present study. All the same, its impact was considerable and it deserves some mention, if only to put later schemes into context.

In July 1738 royal approval was given for the payment of £200 per annum as salaries to William and Andrew Gray for teaching master bleachers from other fields⁵⁵. The conditions under which the scheme operated were strict. Candidates normally had to be proprietors or tacksmen of bleachfields and had to make a bond for £1,000 Sterling not to divulge the information to any other person. Furthermore, they were not to employ any foreign persons at their bleachfields once the Grays' method had been adopted⁵⁶. Despite these rigorous conditions the prestige of Grays' Green was sufficient to draw trainees from most of the major fields then operating or proposed. Figure 16.3 shows the origins of trainees and the dates of their training. This working arrangement, under which the Grays' received £200 per annum, continued to operate until the late 1740's by which time relations between the Board and the Grays had deteriorated somewhat. In 1748 Andrew Gray received two trainees but William Gray refused to instruct either of them and wrote to the Board expressing a wish to end the arrangement⁵⁷. Although the training scheme had come to an end Andrew Gray continued to work for the Board, instructing at new bleachfields and as a travelling inspector⁵⁸. However, his health soon led to disagreements over remuneration: in 1749 he was said to be able to visit only those fields near to Glasgow and in the following year, having failed to make his tour of the bleachfields, Andrew Gray was taken out of the Board's employment⁵⁹.

Other factors also came into play. As has already been noted, the Dutch method, while successful in bleaching fine linen, was unsuited to cheap, coarse linen. Even at their high prices, twenty-five per cent above European rates, Scottish bleachfields were still unable to cope with the coarse linen which represented the bulk of home production⁶⁰. If the Board was to operate a training scheme of any relevance to the the Scottish bleaching industry, it would have to be one which included both Dutch and Irish methods.

Saltoun Field 1751 - 1765

Even before the Board had dispensed with Andrew Gray the search for a suitable field had started. In January 1750 the Board approached William Neilson of Roslin Bleachfield, a man "very expert in his business" and capable of bleaching to a standard "equal to Mr. Gray"⁶¹. Unmoved by the £100 which the Board had offered for passing on his skills Neilson replied "expressing his dissatisfaction at being put upon the same footing with the common rank of bleachers"⁶². However, a much better alternative existed and at the same meeting at which Andrew Gray was dismissed, the Board of Trustees chose the British Linen Company's Saltoun bleachfield as the site of their next training scheme⁶³. In the following

Saltoun possessed several advantages. In February 1749 James Armstrong, then the master bleacher at Saltoun, had been given permission to inspect Andrew Gray's bleaching journal and take copies⁶⁴. In the following month Armstrong was joined at Saltoun by one Doggan who had recently come

over from Ireland, claiming to possess a new bleaching method⁶⁵; that summer the Board had given Doggan £21 to train two apprentices⁶⁶. Saltoun was, therefore, one of the few fields at which both Dutch and Irish methods were practised.

According to the Board's proposals apprentices were to be taken on for three years, with a maximum of four apprentices on the field at any one time. The first two years were to be given over to coarse bleaching and the third to fine; trainees were also to be taught bookkeeping. Journals with day by day accounts of work undertaken were to be submitted to the Board for the second and final years of training and each trainee had to pass the Board's own examination. Apprentices found to be duly qualified as master bleachers were to receive a certificate from the Board and a premium of £50 on setting up a field of at least two or three acres, or on being engaged as foremen at such fields. In exchange for his services the owner of Saltoun, or the instructor there, was to receive £100 per annum out of which the apprentices were to be paid 6d per day⁶⁷.

In January 1751 the British Linen Company accepted its first two apprentices and the salary formerly payable to Andrew Gray was transferred to it⁶⁸. In the following month a third apprentice, who was to have been trained by Andrew Gray, came to the field⁶⁹. Later the same year the Board offered to provide help in building a house "for the better accommodation of apprentices"⁷⁰. By January 1753 twelve apprentices had been taken on⁷¹.

In June of that year the apprentices were given a 1d per day pay rise and lapping, or folding, was added to the curriculum⁷². Instruction was given jointly by Armstrong and Doggan until 1756, in which year the latter left⁷³. Doggan went on to establish Knock Mill bleachfield, Midlothian⁷⁴. By 1773 he was also involved with Ford bleachfield which had been founded in 1753 by Samuel Hart, one of Saltoun's first graduates⁷⁵. At a later date Ford was taken on by another former Saltoun apprentice, John Herdman, who had previously managed Glencorse bleachfield, some ten miles away⁷⁶.

From 1756 until his retirement in 1765 Armstrong had sole charge of the field. For three years thereafter it was run by an Irishman, Samuel Sinclair and on his returning to Ireland his place was taken by Archibald Horn, another ex-apprentice, who had been the manager of the bleachfield at Saltoun barley mill⁷⁷. Long before this time, however, the Board's training scheme had come to an end: in March 1765 Armstrong was notified that as from the following year the £50 per annum, payable for training apprentices, would be withdrawn⁷⁸.

In all, twenty-seven apprentices had passed through Saltoun, of whom about twenty are known to have taken on bleachfields of their own, either as owners or as overseers. Figure 16.3 shows the destinations of these twenty apprentices. It is hardly coincidental that the fields which they founded, or to which they went, represented the greater proportion of the best Scottish bleachfields of the mid to late-18th century and their pre-eminence must owe more

16.3

Saltoun Apprentices. Destinations

<u>Name</u>	<u>Date Started</u>	<u>Destination</u>
James Watson	1751	Deskford (Bff)
Samuel Hart	1751	Ford (M'Loth)
Hector Turnbull	1751	Luncarty (Per)
John Park	1751	Arthurlie (Ren)
Alex Skirvine	1752	Luncarty
William Henderson	1752	Haircraigs (Ren)
Colin Smith	1752	Brechin
Archibald Horn	1752	Saltoun Barley Mill
Charles Baxter	1752	Melrose
Robert Nisbet	1752	Inverness
Robert Monro	1752	Culcairn (Ross)
Robert Smith	1753	Brechin
David Muir	1754	Glorat (Stg)
William Grant	1754	Elgin
David Kennedy	1754	Irvine
William Nisbet	1756	Strichen (Ab'n)
Robert Scott	1758	Balbirnie (Fife)
William Coldon	1759	Cullen
William Hart	1761	Ford
William Tait	1762	Inverness

than a little to the Saltoun training scheme. In a few cases former apprentices moved on after taking on the management of a bleachfield: the examples of John Herdman and Archibald Hourn have already been cited. William Henderson, who took on Haircraigs bleachfield, Renfrewshire in 1754, had moved to Inverness by 1770⁷⁹, while William Tait, who was running the same Inverness bleachfield in 1776, appears to have moved to Culcairn bleachfield, Ross-shire, by 1791⁸⁰. On the whole, however, ex-apprentices appear to have kept to their first field. Perhaps the expense of fitting up a bleachfield contributed to this stability. While most of the Saltoun graduates met with success in their work, the most distinguished career was that of Hector Turnbull. In December 1753 Turnbull, having completed his term at Saltoun, was taken on as a partner in Luncarty bleachfield, near Perth. Such was the size of the field that the Board took the unusual course of giving him his premium of £50 despite the fact that Andrew Skirvine had already been granted the premium for that field⁸¹. By 1756 Turnbull had become overseer and had been asked by the Board to instruct the son of a Dundee thread manufacturer in the art of bleaching⁸²; at least one other trainee was referred to Turnbull before 1773⁸³. In 1777 Turnbull, still at Luncarty, was claiming to have made improvements to bleaching machinery and to have passed them on to anyone who had asked⁸⁴. In the same year the Board, impressed by Turnbull's performance, offered him £100 to instruct two apprentices

in coarse and fine linen bleaching. Unfortunately, an agreement with the owners of the field prevented him from accepting the offer⁸⁵.

Overall, the Saltoun apprenticeship scheme appears to have been very effective and when it did finally come to an end it was as a result of its success rather than its failure in training skilled bleachers.

After 1765

After the termination of the arrangement with Saltoun, the Board occasionally sent apprentices to one or other of a handful of favoured bleachfields and paid for their training. The example of Luncarty bleachfield has already been cited. In 1766 James Macgregor, whose bleachfield at Milngavie employed "the complete Irish method", was offered and accepted £50 per annum over two years to teach Irish bleaching to whoever the Board presented to him.⁸⁶ Despite their assistance in training labour it was very rare for the Board to offer support to working bleachers of the kind they had provided for lint millers (pp.245-6). As we shall see bleachfields were much larger units often backed by mercantile or manufacturing interests and it was, therefore, assumed that the proprietors of bleachfields were better equipped to pay for skilled staff than were the landowners, farmers or artisans who financed lint mills. Moreover, such was the expense of site preparation and the extent and complexity of plant that most of the funds which the Board made available to bleachfields went towards those purposes, leaving very little for the

establishment of a state-financed labour scheme.

Summary

The Scottish bleaching industry's skilled labour requirements were met initially by immigrant bleachers from Ireland supplemented by native Scots. In the early years, however, the quality of their work was often poor and the rates at which they operated too high. By providing master bleachers, thoroughly trained at the best Scottish bleachfields, the Board of Trustees improved the quality of work and brought their prices down to a competitive level. In the 1740's much of the linen produced in Scotland was still being bleached elsewhere. By 1775 most of it was being bleached in Scotland and by the 1790's some English cloth was being bleached there too⁸⁷.

Part of the credit for this turnabout must lie with the Board of Trustees and their efforts to establish a skilled workforce.

Putting all these factors in mind, it is still possible to gain some idea of the number of water-powered bleachfields operating in Scotland. In the years up to 1743 there is evidence that at least twenty-five bleachfields were established and while some small fields, such as Dalbarry⁸⁸, Midlothian, were short lived, the vast majority survived for many years thereafter. Ormiston, Tulloch, Leith and Leven (Pife) all date from this period. A significant number, including Dalgarra, Haddington and Grays' Green used the Dutch method of bleaching and were, therefore, water-powered.

The Bleachfields

Numbers

In attempting to assess the number of water-powered bleachfields once operating, one is immediately faced with the problem of disentangling those using the Irish method from those using the Dutch. The principal source materials, notably the Minutes of the Board of Trustees, the Old Statistical Account and newspaper advertisements cast some light on the problem and it is fairly safe to assume that most of the larger and later bleachfields used the Irish method, unless the Dutch is specifically mentioned. Furthermore the scale of water-powered bleachfields and their frequent recourse to advertising, lessens the chances of their going unrecorded. On the other hand there is no single source comparable to the lint mill survey of 1772. Unlike lint mills, many bleachfields continued to operate after 1830, sometimes with the addition or substitution of steam-power.

Bearing all these factors in mind, it is still possible to gain some idea of the number of water-powered bleachfields operating in Scotland. In the years up to 1745 there is evidence that at least twenty-five bleachfields were established and while some small fields, such as Carberry⁸⁸, Midlothian, were short lived, the vast majority survived for many years thereafter: Ormiston, Tulloch, Roslin and Leven (Fife) all date from this period. A significant number, including Dalquhurn, Haddington and Grays' Green used the Dutch method of bleaching and were not, therefore, water-powered.

Between 1745 and 1765 at least sixty-five additional fields were established, almost all of them water-powered. However, as some of the smaller bleachfields of the previous period had already gone out of use, this does not represent an absolute increase. Most significant of the bleachfields established during this period was Saltoun, whence came the bleachers who founded or operated about twenty of the other major new fields. Ironically Saltoun itself survived for only a short period after 1765.

The period 1765 to 1790 saw the greatest number of new bleachfields, with over a hundred established between those years. Significant among them were Leven (Dunbartonshire), Huntingtower, Dollar and Inglis Green. While the trend was towards larger, more complex fields, there were some on a very small scale, such as that at Bedrule Mill, Roxburghshire⁸⁹. According to Clow, there were about ninety bleachfields in Scotland by 1772, distributed as follows:

Aberdeenshire 5; Ayr 3; Banff 5; Berwick 2; Dunbarton 3; Dumfries 3; Edinburgh 14; Elgin 1; Fife 13; Haddington 6; Inverness 1; Kincardine 1; Kinross 1; Lanark 8; Linlithgow 1; Orkney 1; Perth 6; Renfrew 3; Ross 1; Roxburgh 1; Selkirk 1; Stirling 3; Forfar 9.

At least thirty more bleachfields were set up in the 1790's including Prinlaws (1790) and Letham (Angus)(1792). By this time there was little need for additional bleachfields and the contraction of the linen industry in some areas may have led to an overall decline.

Between 1801 and 1830 only about ten new fields were esta-

blished, and these, for the most part, were in west Central and eastern Scotland. Outwith these areas the period was characterised by a marked drop in the number of fields.

Distribution

Throughout the period 1730 - 1830 the location of water-powered bleachfields was closely related to the changing needs and location of the linen, and latterly also the cotton, textile industries. Over and above this, however, there was a broad pattern of diffusion and contraction.

In the period up to 1745, bleachfields were most common in south-east Scotland, with minor concentrations in the Edinburgh area and the upper Merse. Outwith the south-east there were only a very few sites in the rest of the central Lowlands and two in the Dumfries area.

However, between 1745 and 1765 bleachfields became much more widespread and although a significant number of new fields were created in the south-east, the centre of gravity shifted to east central Scotland. In the north-east the influence of merchants and improving landowners is seen in the creation, for the first time, of about ten fields, while in the south-west, where only two fields were recorded before 1745, at least twelve more were created between 1745 and 1765. In the Highlands too, a handful of improving landowners established fields, though probably more from a "spirit of industry" than from an existing need for them.

Between 1765 and 1790 east central Scotland continued to maintain the dominant position which it had established between 1745 and 1765, with at least twenty-five new fields

during the period. The north-eastern area continued to increase in importance, with fifteen new fields. While fields continued to be built in all areas, there was a notable increase in the number of fields in the Highlands and Islands, particularly in Inverness-shire. With the establishment of Catfirth bleachfield in Shetland, the diffusion of Scottish bleachfields reached its zenith. The 1790's saw a marked contraction in the building of new bleachfields. Only in east central Scotland, where yarn bleachfields were built to serve flax spinning mills, were new fields built in any significant numbers. Elsewhere, despite the construction of a few new fields, there may have been a net reduction in the total number of fields operating. During the period 1800 - 1830 this was certainly the case. For the most part existing fields were able to cope with demands and with the contraction of the linen industry many fields, particularly those in marginal areas, ceased to be financially viable. While some of the existing fields, especially those in eastern and west central Scotland, continued to operate up to and beyond the end of the 19th century, the building and operating of bleachfields in most parts of Scotland had come to an end. Figure 16.4 shows the distribution of known and probable water-powered bleachfield sites between 1730 and 1830.

Finance

While the establishment of a lint mill required a certain amount of capital it was, with the aid of the Board of Trustees, within the means of a large tenant or small



landowner. However, a considerably greater amount was needed to establish a bleachfield, especially if the field was to have water-powered machinery. True, the Board of Trustees provided some aid, often in the region of £100 or more, but this was only made available on the work being completed. Furthermore, the limitations of the Board's funds prevented it from providing anything more than a small proportion of the capital cost of larger fields, on which the total outlay could be several thousand pounds. The role of the Board was, therefore, only of secondary importance; first we must establish who it was that laid out the capital initially. From approximately one hundred sites for which information is available it would appear that they belonged to four major groups: companies and other partnerships, individual-merchants and manufacturers, landowners and persons from related textile trades.

Companies and other Partnerships

The first group comprised both true companies and less formal partnerships. Notable among early examples of the latter sub-group was the fraternal partnership of William and Andrew Gray, two Glasgow merchants who founded Provan Mill bleachfield in 1728⁹¹. It was another partnership of Glasgow merchants who founded Dalquhurn bleachfield also in 1728⁹². Family and other partnerships continued to be of some, albeit limited, significance throughout the period up to 1830 and notably between 1745 and 1790. Companies began to come into evidence in the 1740's, most significantly the British Linen Company, whose Saltoun

bleachfield was founded c. 1748⁹³. Other early companies included Leyes, Still & Co. (Gordon's Mills, pre 1755) and Rannie, Fordyce & Co. (Deskford, 1752). For the rest of the period company-financed fields continued to represent the largest single group of new bleachfields. While it is outwith the scope of the present enquiry to analyse the composition of companies, the little evidence that is readily available points to a significant contribution to the formation of companies by both merchants and landowners. The partnership of Wallace, Gardine & Co. (Arbroath, 1746) consisted of three Arbroath merchants⁹⁴. The two principal partners in Richardson & Co. (Huntingtower 1772) were Sir John Richardson of Pitfour and Robert Smythe of Methven⁹⁵. The firm of Sir John Mitchell & Co., founders of the ill fated Catfirth bleachfield in Shetland, was financed by Shetland landowners⁹⁶ and while it was "the Linen Company at Granttown" which operated the bleachfield there, most of the initiative came from Grant of Grant himself⁹⁷. In the case of J. King & Co. (Mid-Arthurlie) the situation was even more complex: of the two partners one, A. Brown, was a merchant and baillie in Paisley while the other, who gave his name to the company, was a bleacher but also the owner of the lands of East Carriagehall near Paisley⁹⁸.

Individual Merchants and Manufacturers

Less common than company fields were those founded by individual merchants and manufacturers. Almost all of the fields in this category were situated in the east of Scotland and generally were smaller than company fields.

The most notable exception to the rule was Luncarty, founded in 1752 by a Perth merchant, William Sandeman⁹⁹. More typical were Arrat (A. Glegg, merchant in Montrose, 1789), Milton (G. Morrison, manufacturer in Keith, 1789) Strathendry (R. Birrel, merchant and manufacturer in Kirkcaldy) and Elgin (J. Ritchie junr, merchant in Elgin, 1785).¹⁰⁰ Most of the merchants and manufacturers involved were already concerned with either the marketing or production of linen and may have seen bleaching as a way of extending their interests in the industry. It is noticeable that most of the fields in this category date from the period 1765 - 1789, particularly the 1780's, by which time sufficient capital had been accumulated to make such an investment. After 1790, in times less certain for the linen industry and in circumstances favouring large, highly capitalised fields, individual merchants and manufacturers all but disappeared from the scene. Obviously the time when a merchant could "go it alone" had passed.

Landowners

The contribution of the third major group, landowners, is more difficult to assess. On the one hand, as has already been shown, landowners often formed the nuclei of companies and, on the other hand, successful merchants and manufacturers often became landowners: the example of J. King has already been cited. Besides this "invisible" element, there is also evidence of a significant number of landowners who took the initiative to establish bleachfields on their own account. One of the earliest examples was Colonel Hamilton-Price of Raploch who, having previously

set up a weaving community, founded a bleachfield at Laverockhall in 1729¹⁰¹. Although a handful of other landowners, such as Wright of Lawton, established bleachfields during the next thirty years it was not until the 1760's that they appeared in any numbers.

In 1761 John Adam of Blairadam established a bleachfield at the new village of Maryburgh on his Fife estate¹⁰²; Dunfermline bleachfield was founded in 1763 by the Earl of Elgin¹⁰³ and Portsoy bleachfield in 1767 by Lorimer of Portsoy¹⁰⁴. After a lapse during the 1770's there was a revival of interest in the 1780's, starting with Gordon of Glendavenny's Peterhead bleachfield in 1780¹⁰⁵. Among those which followed were the Laurencekirk bleachfields of Lord Gardenstone (pre-1785), Pitsligo bleachfield (1785), laid out at a cost in excess of £1,000 by Sir William Forbes of Pitsligo, Cumnock (1785), laid out by the Earl of Dumfries, Kingussie (1785), by the Duke of Gordon, Ness (1787), by Baillie of Dunain and Thurso (1789), by Sir John Sinclair of Ulbster¹⁰⁶.

After 1790 there is very little evidence of landowners laying out large sums of money on establishing bleachfields. By that time attention had turned to carding and spinning mills for wool in the Borders, Hillfoots and north-east Scotland, for linen in east central Scotland and for cotton over much of Scotland, but more especially in the west. Although a few landowners undertook directly to build such mills, it was more usual for them to offer sites on their estates to merchants or manufacturers. Where new bleachfields were established after 1790 it was usually

at the initiative of those merchants and manufacturers as an adjunct to their spinning mills.

Textile Trade Employees

The final group, textile trade employees, came from very diverse backgrounds: threadmakers, weavers, stampmasters, a lint miller and, most commonly, bleachers. Several Irish bleachers founded their own fields in Scotland, notably in the early years of bleachfield development. The Christies (Kinchey 1734), Ormiston (1731) and Tulloch (1735) were certainly Irish as probably were the McWhirters (Trailflat (1776) and Dounieston (1808)¹⁰⁷. One William Adair from Lismore field, Ireland, set up at Cross-Arthurlie in 1773 after allegedly having sailed up the Clyde without seeing a single bleachfield¹⁰⁸.

A few of the Saltoun apprentices went on to found their own bleachfields. One of the first, Samuel Hart, obtained a tack of land at Ford, Midlothian, from Dewar of Vogrie in 1753 and built a bleachfield there¹⁰⁹. Another Saltoun trainee, William Henderson, set up a bleachfield at Haircraigs, Renfrewshire, in 1754 on land let to him by T. Caldwell, a Paisley merchant who had bought the estate in 1749¹¹⁰. A third apprentice, Robert Munro, seems to have been responsible for the establishment of Culcairn bleachfield, Ross-shire but in this case, as in others involving bleachers in this capacity, one suspects that more than a little help was provided by landed or mercantile interests. Most of the Saltoun apprentices took on supervisory rather than entrepreneurial roles and, while a few bleachers became partners in bleachfields,

their contribution was probably skill rather than capital.

All in all there was no room in the bleaching industry for the small farmer or tradesman who became so prominent in flax milling and for the most part it was landowners, merchants and manufacturers who established bleachfields, for it was only they who could bear the cost of setting up and running a field of any size.

The Cost of Bleachfields

The capital laid out on creating bleachfields varied enormously. A small bleachfield without machinery could cost as little as £100, whereas a fully equipped field with several acres of drying field could cost several thousands.

Fixed Capital Cost Components

Once land had been purchased, feued or let, the first task was to level the site and form irrigated greens.

This alone could cost several hundred pounds: at Montrose field, where no machinery was installed, £208 had been applied to this purpose by 1754¹¹¹ and by 1755 Samuel Hart had spend £416 on laying out the field at Ford¹¹².

In the case of water-powered bleachfields dams and lades also had to be constructed, although existing ones were sometimes used: Tulloch bleachfield, for example, was on the long-established Perth town lade¹¹³.

The site having been prepared, a number of buildings had to be constructed. A boiling house could cost £100 and a drying house anywhere between £68 (Gifford 1754) and £500 (Saltoun 1752)¹¹⁴. In addition there had to be

buildings to house machinery, keives and tubs. Machinery could be a major item of expenditure, especially if a field was to have a full set comprising washing mill, beetles, rubbing boards and callender. Machinery and housing at Brechin bleachfield, for example, cost £238 in 1785¹¹⁵. Even after a field had been fully equipped it was only a matter of time until a refit was necessary: repairs to machinery at Deanshaugh bleachfield, Elgin, cost £147 in 1824, while £359 10s 9d was spent on renewing the machinery and drying house at Roslin in 1761, only twenty-three years after it was founded¹¹⁶.

All told, the cost of a moderately sized field was often about £500 to £800: Douglas (1774), Deskford (1752), Glasgow (1753) and Meigle (1805) are typical examples¹¹⁷. The cost of a smaller field such as Pitsligo (1785), Strathmiglo (1756), Arthurlie (1754) or Blackland Mill (1776) was in the region of £150 to £400, while a large field could cost between £1,000 (Inglis Green, 1774) and £4,000 (Stormont, 1791)¹¹⁸. The expenses involved in constructing Luncarty bleachfield (1752-1762) are detailed below:

Accompt of Money Expended upon Luncarty Bleachfield from the Beginning of the Year 1752, when it Began to be Fitted up to 4 August 1761

	£	s	d
1752 Oct - Accompt for levelling and laying out 12 acres of bleachfield and building a boiling house, with house for a water mill for washing and rubbing cloth after the Irish method	755	6	4 $\frac{1}{2}$

		£	s	d
1753	Laid out further before completion	470	6	0 $\frac{1}{4}$
Nov	A press for lapping after the Dutch method			
		73	3	3
1754	A house for holding a beetling machine and room for lapping cloth	175	7	7 $\frac{1}{2}$
	Beetling machine	102	15	11 $\frac{1}{4}$
	Fencing about the waters	28	8	1
1756	Sundry new utensils, large keives etc.	26	15	8
1757	A machine for pounding ashes, with improvements on rubbing boards	47	13	8 $\frac{1}{2}$
1758	Dwelling house	200	0	0
	Sundry improvements to machines and extending bleachfield ground	78	13	5 $\frac{1}{4}$
1759	Large house for 18 tubs for 36 women to wash and rub cloth after the Dutch method, and laying out 3 acres of bleachfield	193	19	6 $\frac{1}{2}$
1760	Large house for servants. House for rinsing and blueing cloth. 1 $\frac{1}{2}$ acres more bleachfield	177	15	11 $\frac{3}{4}$
		£2,486	14	7
1761	House 36 feet by 20 feet for holding milk casks and keives for souring cloth	30	0	0
Built and finishing	House 32 feet by 24 feet - ground floor for holding ashes etc.			
	2 timber floors for holding and lapping linen	150	0	0

Fortunately the Scottish bleacher, undercapitalised as he often was, could usually obtain some help from the Board of Trustees and it is to their contribution that we must look next.

Extent and Purpose of Aid

We have already seen the extent to which the Board of Trustees provided aid towards the construction of lint mills (p.275). The capital required in establishing a bleachfield was considerably greater and, as might be expected, the contribution of the Board was correspondingly greater.

Initially, from 1727, this aid took the form of a £50 per acre grant. This very high level of assistance meant that in the case of one field, Dalquhurn, the proprietors received no less than £600, while another field, Cameron, received £450. In all, only eight bleachfields benefitted from the scheme before the £2000 allocated to it ran out.

Gorgie	6 acres	£300
Grays Green	7 acres	£350
Cupar	4.5 acres	£225
Dalquhurn	12 acres	£600
Cameron	9 acres	£450
Aberdeen	1 acre	£50
Tipperlin	?	£25
		<hr/>
		121
		<hr/>
		£2,000

Besides benefitting only a few fields, and those to an excessively great extent, there was no assurance that the fields, once established, would operate effectively

nor that they would continue in business for any length of time.

By the late 1730's the policy of the Board of Trustees had changed to give a more equitable distribution of funds. Even so, only a few fields benefitted - four between 1735 and 1739, two between 1740 and 1744 and six between 1745 and 1749. In the late 1730's some very large grants were still being awarded, notably to Grays' Green which was given £1,000 in 1738 towards construction and improvements¹²². Ormiston received a further £200, Roslin £150 and Tulloch £300¹²³; altogether these four received more aid than did some thirty-four separate fields in the period 1780 - 1789.

The early 1750's saw a fourfold increase in aid through which thirty-one fields were granted sums varying from £20 to £200. Much of this was taken up with investment in drying houses towards which, for example, Saltoun field received £200 and Ayton £100¹²⁴. The scale of aid to any one field was still falling in the late 1750's during which a little over a half of the sum made available in the previous five years went to twenty-three fields. Here again, drying houses accounted for a substantial proportion of the aid.

Up until about 1760 aid had been directed, for the most part, towards earthworks and buildings. Thereafter, however, funds were made available for the increasingly complex machinery which bleachers were having to install. In 1762 Deskford bleachfield received £50 towards rubbing boards and other improvements while another £60 went to-

wards the cost of a set of beetles at Saltoun Barley Mill bleachfield¹²⁵. In 1768 Ormiston received £50 towards a washing mill and a lignum vitae cylinder¹²⁶. Between 1760 and 1769 twenty-nine fields shared a total of £1,840. During the early 1770's the aid to fields, buildings and machinery rose to £1,245 shared among twenty bleachfields. In the late 1770's the value of aid fell back sharply but recovered slightly between 1780 and 1794. A fairly large proportion of the aid granted during this period went towards the extension and renewal of buildings and machinery, although some new fields were still being created. After 1794 aid fell to a very low level and remained there. On the one hand the financial impetus had passed to various kinds of spinning mill while, on the other hand, the funds at the Board's disposal were being increasingly directed towards the revitalised woollen industry. In the thirty-five-year period 1795 - 1830 less was paid out in grants to bleachfields than in the five-year period 1750 - 1754.

Policy

Three main points of policy emerge from the minutes of the Board of Trustees. Firstly, as with lint mills, aid towards bleachfields was only granted after most of the work had been completed. While this virtually eliminated the misuse of funds, it meant that the work had to be financed either by credit or, that if capital was available, there was no need for the aid in the first place. A second point of policy was to restrict the number and total value of grants to any one field, so that deserving

projects were often turned down solely on the grounds that money had already been given towards other works at the field in question. There were, of course, exceptions, particularly in the case of highly successful fields. Thus Luncarty received £375 in four instalments between 1752 and 1764, Deskford £400 in seven instalments, 1753 - 1821 and Ormiston £800 in six instalments, 1734 - 1768¹²⁷. Grays' Green, which received no less than £1,350 has already been mentioned, but the most remarkable breach of policy was at Roslin bleachfield near Edinburgh. Roslin bleachfield was founded in 1738 by William Neilson. In the same year he received £150 towards setting up the field¹²⁸; in 1747 the Board granted him a further £100, this time for repairs and improvements¹²⁹. By 1750 he had gained an excellent reputation as a bleacher and was approached, unsuccessfully, by the Board as a possible successor to the Grays¹³⁰ (p. 310). In 1752 he was given an additional £100 and in 1759 £200, the latter being for a drying house and repairs¹³¹. In 1761 he received a further £100 towards the same, the total sum expended by him being £359 10s 9d¹³². In 1771, when David Ross, a new bleacher there, applied for aid it was turned down on the grounds that £750 had already been granted to the field, but the following year his request for aid towards the cost of a washing mill, rubbing boards and other bleaching machinery was accepted and £100 given towards the £314 13s 10d which had been laid out to that end by 1773¹³³. By the late 1770's ownership of the field had changed once again. In 1779 the new occupants, John and

Walter Biggar, were given £50¹³⁴. Finally, in 1808, £60 was granted to Samuel and Charles Read, tacksmen of Roslin bleachfield, for work on machinery there¹³⁵. In all Roslin had been given financial assistance on no fewer than nine occasions, amounting to £900. The third policy concerned the distribution of bleachfields. On the whole the Board were reluctant to support fields in areas such as Renfrewshire where bleaching was already well established and on several occasions aid was withheld on these grounds. See e.g. N. Arthurlie, Paisley and Irvine)¹³⁶. However, here again there were exceptions: the Board's attitude towards Stormontfield, founded by two Perth merchants in 1789, was initially one of indifference, and when it was approached for aid, it was withheld on the grounds that there were already sufficient fields in the area. Nevertheless, a testimonial by Lady Henderland and a favourable report by the Board's own surveyor were sufficient to persuade it to give the field £300 over three years¹³⁷.

Overall, the financial contribution of the Board of Trustees must have been of significant proportions, coming at a time when many Scottish bleachers were seriously undercapitalised. However, it cannot really be considered crucial, as most fields had laid out money before the Board provided any return and at least the larger better capitalised fields could have survived without it. All the same, the Scottish bleaching industry would have been noticeably the poorer without the £16,243 which the Board provided between 1728 and 1830.

A Scottish Bleachfield

Saltoun, East Lothian

As the most important and one of the best documented fields in Scotland, Saltoun is an obvious choice to examine in detail. Since other aspects of the field have already been considered, attention is centred on the establishment and construction of the field. The British Linen Company for whom the field was built, had been founded in March 1745 by Lord Milton and two merchants, William Tod and Ebenezer McCulloch. On 5th July 1746 it was given a Royal Charter¹³⁸. As the best Scottish bleachfields such as Grays' Green and Roslin were already constantly employed, the company was forced, initially, to send its cloth to other Scottish fields or even to London¹³⁹. Before long however, the problems of doing so had become evident and the company had to seek an alternative. In the words of the company's minutes:

"The managers represented that the price commonly paid the bleachers in this country for whitening of linen was so great a charge on the manufacturers that without a saving in that article, they could bring no quantities to the London market, at a price equal to the foreign; that the only method which had occurred to the directors and managers was for the company to take a field for bleaching coarse linens; and to employ some skilled bleacher to manage the same at a certain salary or proportional part of savings that might arise to the company, betwixt the price that bleaching might cost and the price now paid to the bleachers in the country;

that they represented that the Lord Justice Clerk had agreed to erect a bleachfield for this purpose, and enter into tack with the company, at the rate of twenty shillings sterling yearly, for each acre of ground that might be employed in the field, and of seven pounds ten shillings per cent per annum, for the money laid out by his lordship in erecting the same"¹⁴⁰.

The choice of Lord Milton's estate was an obvious one. Firstly, besides being a founder member of the British Linen Company, he served on the Board of Trustees for Manufactures and could be relied upon to obtain financial aid from it. Secondly, his estate in East Lothian was only fifteen miles from Edinburgh, still, at that time, the centre of the linen industry and of the company's activities. Thirdly he had access to the resources required: good haugh land beside Saltoun Water, water-power potential on the same stream and, in Robert Meikle, then resident at Saltoun, a first-rate millwright. Last but not least, he had capital. In the event Lord Milton lent the money for the field's construction interest free and allowed the company to use the field rent free until such time as it became profitable.

Although the company had had to wait until September 1747 for a quorum the decision had already been taken and construction work had started in 1746¹⁴¹. Before the end of that year progress had been made on preparing earthworks and water works, while George Merylees had done some smith work. During 1747 construction work was in full swing. By June of that year Robert Meikle, aided by a workforce

which included his brother Andrew, had completed the brass, iron and woodwork of the upper mill, the first two at a cost of £12 1s 4½d and the last, including axletree, stock and two wheels, at £18 11s. Besides the washing mill, the upper mill also housed rubbing boards, probably to the Meikles' own improved design (see p.302).

Between August and September 1747 one hundred and twenty-three cart loads of timber were brought from Prestonpans; in that same year sixty-nine bars of iron were purchased from Messrs. Fall, merchants in Dunbar and twelve from Mr. Caddel, merchant in Cockenzie. In all £653 0s 8d was laid out on the field during 1747.

Work continued into 1748 and Robert Meikle's attention now turned to the Lower Mill. By October he had completed the iron and brass work and had blocked out the woodwork. Before the end of 1748 he had added a lint mill to the machinery. By May of that year a great number of cartloads of iron, deals, rough timber and other materials had been brought to the field, including eight loads of brick from Lord Milton's Brunstane estate, just east of Edinburgh. During July and August fifty-five cartloads of deals and logs came from Port Seton and one cart carried a plane tree from Brunstane.

Slating work on the mills and dwelling house was carried out by a Dalkeith slater, Thomas Burns, using slate from Auchinleck. Estimates at the time put the number of slates required at 28,000; a cart could carry two hundred and fifty. Tiles, probably imported via Port Seton, were used in roofing shades. Lime for plastering the

the roofs and for cementing stonework probably came from Herdmanston limeworks near Haddington. In all £793 16s 5d was expended on the field during 1748.

Although the field began to operate in that year, construction work continued until 1750. The establishment of the field had involved the carriage of tiles, bricks and trees from Brunstane, timber from Leith and Prestonpans, timber and iron from Port Seton, timber, scaffolding and iron from Fisherrow, slates from Auchinleck, stone from Tranent and elsewhere, iron from Dunbar, trees from Saltoun Parks, lime from Herdmanston and sand from locally dug pits. There is evidence of at least four hundred cartloads of materials going to the field; the total is probably considerably higher. In all, by the end of 1750, Lord Milton had laid out £2,123 13s 6d¹⁴². The completed field, with later additions, appears in figure 16.5.

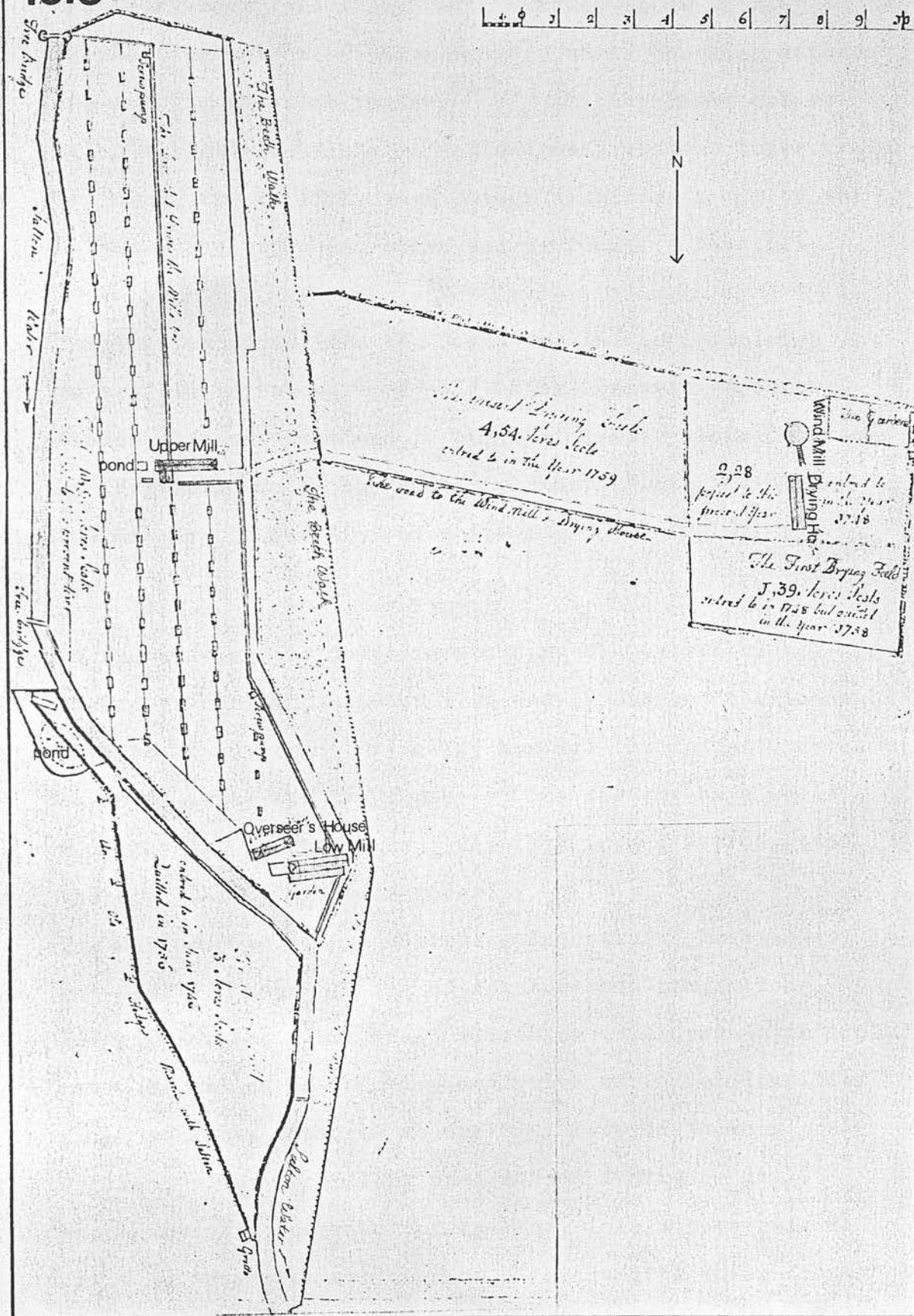
As has already been stated, work on establishing the field finished in 1750. After that date repairs and additions continued to be made; those to the bleaching and drying greens are detailed in figure 16.5. In 1752 the Board of Trustees gave £200 towards a drying house costing £509 11s 3d¹⁴³. Some eight years later, following a visit of inspection to a beetling mill at Perth, Robert Meikle prepared one to his own design and installed it at Saltoun¹⁴⁴. Between 1750 and 1762 Lord Milton spent £536 10s 6d on repairs and additions to the field¹⁴⁵.

Innovations were also made in the chemistry of bleaching and during 1752 experiments were made in the use of oil of vitriol (H_2SO_4) from John Roebuck's Prestonpans works¹⁴⁶.

16.5

Scale of Scots Chains & Scots Ells each

1 2 3 4 5 6 7 8 9 10



The field finally closed down in 1772. By that time the machinery comprised three water wheels, three washing stocks, two sets of rubbing boards, three beetling engines and two lignum vitae rollers¹⁴⁷. Although Lord Milton tried to sell the field it would appear that no buyer could be found, for by 1777, when Mostyn Armstrong's map of the Lothians was produced, there was no longer a bleachfield at Saltoun¹⁴⁸.

Despite its short life the impact of Saltoun continued to be felt in the work of skilled ex-trainees at bleachfields all over Scotland. For that reason alone it must be considered to be the most important single field in the history of Scottish bleaching.

Summary

In summarising the development of water-powered bleachfields in Scotland between 1730 and 1830 three questions have to be answered: firstly, how did the industry develop; secondly, what was its impact on the economy as a whole and thirdly, to what extent was this impact a product of the application of water-power?

The development of the bleaching industry in Scotland between 1730 and 1830 was of considerable proportions. Indeed, for the first time, something developed which truly could be called an industry and which could be identified in many of its features as the precursor of factory production. The technology used turned a simple, small scale activity, carried out by hand, into a sophisticated craft in which the application of mechanical power created a capital-intensive industry in which the process could

be carried out cheaply and on a large scale at any one site. The application of chemical science also revolutionised the process by removing its dependence upon plant and animal materials and by permitting bleaching to be carried out rapidly indoors, instead of outdoors over several months at the mercy of the weather. The workforce showed an unprecedented degree of specialisation and at the larger fields they were employed in considerable numbers. Both features were typical of factory production and, as one might expect, bleachfields produced some of the earliest examples of purpose-built industrial housing. Because of the need to carry out field levelling, canal digging, building and the installation of expensive machinery, the capital required to establish any but the smallest bleachfields was usually beyond the means of the ordinary landowner, farmer or artisan. In this context the only industries which had required such investment prior to that time were the mining and smelting of lead and silver and the mining of coal. In the former case finance had come from the Crown and in the latter from landowners made wealthy by export sales of coal. In the case of the bleachfields the money tended to come from individual merchants and landowners or from co-partneries comprising either or both groups. While these were by no means the first examples of such companies¹⁴⁹ it was only with the financing of bleachfields that they became common in Scotland. In the light of later developments, namely cotton and linen spinning, this familiarity with joint-stock organisation and the capital accumulated by them, becomes

of even greater significance. Devine¹⁵⁰ has recognised in the textile finishing industries a link between the capital accumulated in colonial trade and the capital later laid out in the cotton industry. Taking a conservative estimate of £500 as the average unit cost, something in the region of £100,000 must have been laid out on bleach-fields in Scotland between 1730 and 1830. To turn to the second question, what was the impact of the bleaching industry on the Scottish economy between 1730 and 1830? Undoubtedly it was of major importance. In 1730, while the linen industry was already of significant proportions, all processes were still carried out by hand, in small scale units. Although the quality of work was poor at all stages of production, it was in bleaching that the greatest improvement was needed, since only by sending cloth abroad could it be finished to a quality at a price that made it competitive. However, through the work of the Board of Trustees and that of individual millwrights, bleachers and scientists, a bleaching industry was established which in terms of rates and quality of work could equal that of Holland or anywhere else. As the bleaching process could now be carried out within Scotland and cloth could be bleached more cheaply the capital accruing from bleaching remained in the country, often to be re-invested and the manufacturer could be more certain of getting his web back again in a shorter period. Because of its labour requirements the linen bleaching industry was able to go some little way towards absorbing surplus workers at a time when

radical changes in agriculture were throwing great numbers off the land. The significance of the bleaching industry in the accumulation of capital has already been discussed. Finally, to what extent was the impact of the bleaching industry due to the application of water-power? In terms of scale of operation and quality of finish the use of waterpowered machinery was of major importance, though not the only factor. Although the initial capital outlay might be great, machinery could soon pay for itself, either through savings on wage labour or by achieving economies of scale. In one example, cited by Durie¹⁵¹, the beetling engine installed at Saltoun in 1760 double beetled 288,458 yards of cloth and 486 table cloths between March 1761 and March 1762. The cost of doing this by hand at the Edinburgh lapping house would have been £329; deducting £91 per annum for running costs, the beetling engine made £238 per annum extra and in three seasons would have paid for itself.

While some bleachfields followed the Dutch method of bleaching and did not therefore require water-power, their competitiveness was based on the high quality of their work and of the cloth which they bleached. It was, however, the coarse linen industry which made the greatest contribution to the Scottish economy and a crucial stage in its manufacture was a bleaching process which utilised mechanical power. In a few cases horses provided it and in the 19th century the steam engine came into use. For the most part, however, water provided the power and continued to do so, in some cases, until the middle of

the 20th century¹⁵².

One should not over-emphasise the significance of water-power in the development of the bleaching industry as a whole. One might equally cite the availability of suitable sites with clear water near centres of population, the availability of capital to establish fields, the active co-operation of the Board of Trustees, the application of chemical science or the existence of markets for finished cloth in England, Scotland and the colonies. On the other hand the contribution made by water-power should be recognised as being greater than that generally acknowledged. Indeed, without it the bleaching industry might never have assumed the proportions which it did, nor might it have contributed so much to the economic development of Scotland between 1730 and 1830.

153

Only a week later a third petition was submitted by John Forester & Co., Stirling, but in the Board's Minute Books this is overshadowed by a detailed account of Messrs. Chapp & Neilson's methods. According to their estimation, public boilers would clean 1000000000 yds at 3d per pound, but their mill could clean an equal quantity for 1d in a far shorter time. The Board were sufficiently impressed to put forward £50 towards the cost of an experimental mill, the total cost of which was to be £112 7s. 11d. 342

154

During the early 19th century bleachfields for linen yarn began to replace traditional cloth bleachfields. Stimulated by the vastly augmented output made possible by the mechanisation of spinning, many large yarn bleachfields were set up in east central Scotland, but the process was also carried out at small-scale yarn washing or plash mills. Whilst these came to be associated with spinning mills, their origin goes back to an earlier period and the earliest recorded plash mill was not situated in the heartland of flax mill-spinning but further south in Edinburgh. In 1748 the Board of Trustees was presented with two similar requests for financial aid in connection with machinery to clean yarn by water power. According to the first, Messrs. Cheap & Neilson, manufacturers in the Canongate, claimed that they could clean yarn for Osnaburghs in half the usual time, while the second petition from Messrs. Bell & Murray, manufacturers, made much of the cheapness, relative to manual methods, with which yarn could be cleaned using water power¹⁵³. Only a week later a third petition was submitted by John Forester & Co., Stirling, but in the Board's Minute Books this is overshadowed by a detailed account of Messrs. Cheap & Neilson's methods. According to their estimates, public boilers could clean coarse linen yarn at 3½d per pound, but their mill could clean an equal quantity for ¾d in a far shorter time. The Board were sufficiently impressed to put forward £50 towards the cost of an experimental mill, the total cost of which was to be £112 7s; little did they realise that the eventual cost was to be more than twice this sum¹⁵⁴.

The site chosen was at Bonnington Mills, Edinburgh, where less than twenty years earlier James Spalding had built his experimental lint mill. By July 1748 work was under way and Messrs. Cheap & Neilson were claiming the balance of the £50 offered to them¹⁵⁵. However, the choice of site was not a wise one: according to a report prepared by Hope of Rankeillor, the position of the mill, the projected fall and the height of the trows were such that it seemed unlikely that the mill would ever work. As the yarn mill had been built on the tail lade of an existing corn mill, it could only operate when the corn mill was at work¹⁵⁶; by August 1748 the projected cost of the mill had reached £300, forcing the Board to take it over on their own account and complete it at public expense¹⁵⁷. Following the submission of Hope's report, two millwrights, Landale and Muckle (Meikle?) were called in. Meikle started by making a model of the mill; by July 1749 hopes were being expressed that the yarn mill might soon be completed and in anticipation of this, rates for yarn washing were drawn up¹⁵⁸. Notwithstanding this apparent optimism, the Board were still conferring with both Andrew and Robert Meikle later that month, having instructed them to work only on those parts of the mill which could be moved elsewhere. A further indication that all was not well came from the Board's moves to find an alternative site at Canonmills, but by the time that negotiations were concluded in January 1750, the mill at Bonnington had been completed at a cost of £251 10s 3d¹⁵⁹. No more is heard of the mill, other than that it was still functioning in 1758¹⁶⁰. By that time the plash mill had

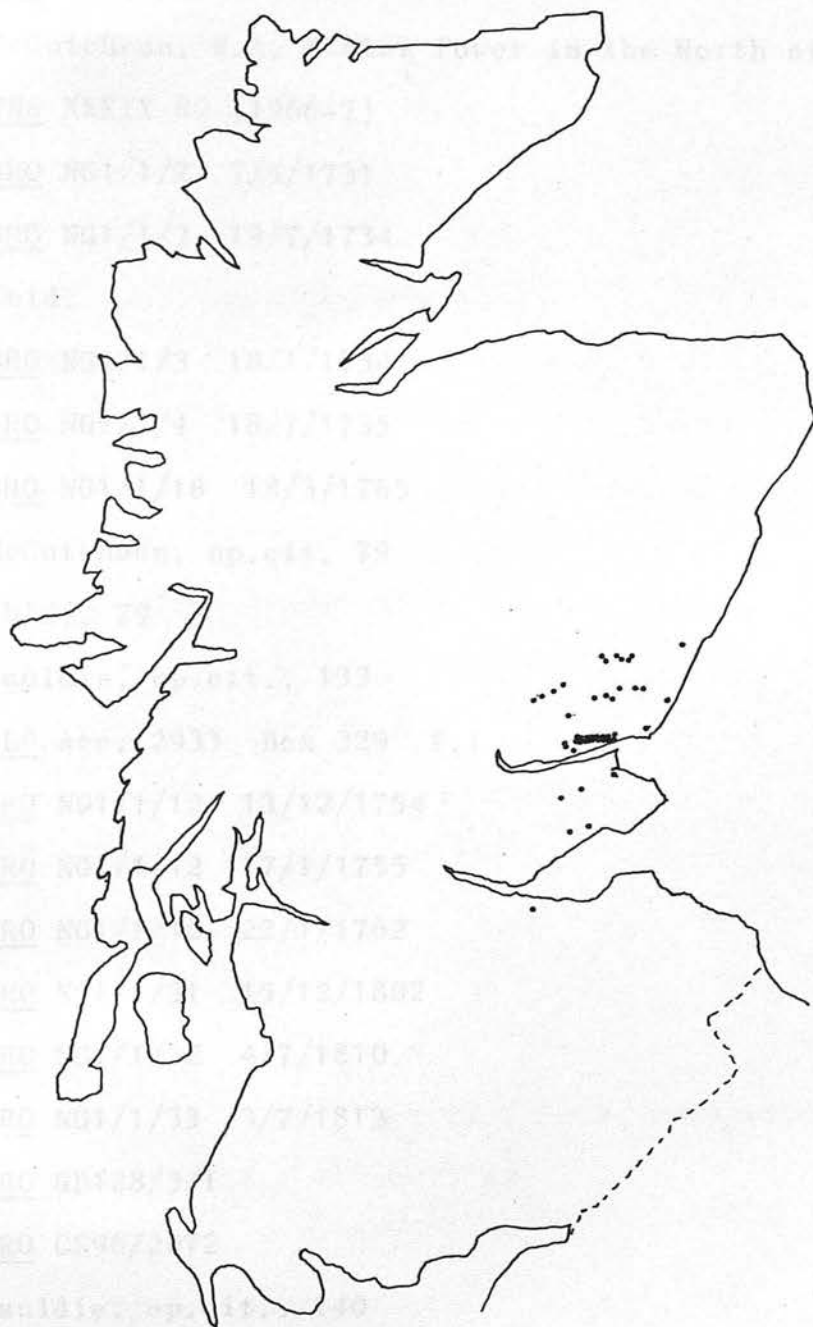
become well-established elsewhere, in east central Scotland. According to Hay's "History of Arbroath" Nether Mill, near Arbroath was converted to wash yarn c.1740, a function which it continued to perform until 1863¹⁶¹. Whilst it seems improbable that such a mill existed at so early a date, a report dated 1760 confirms that several plash mills had been built by that year:

"Milns are used in Angus for cleaning coarse yarns and therefore the cleaning in general is proposed at first rather than confining them to ashes"¹⁶².

The writer went on to suggest that the linen industry might benefit from the wider adoption of this technique and proposed that, for a trial period no coarse yarn should be sold unwashed in Fife, Angus and Perthshire. Although the paucity of mills at that time would have made the experiment impracticable, additional mills were built from time to time, though only rarely with the assistance of the Board of Trustees. By 1790 there were probably thirty or so plash mills at work in Scotland, by far the largest concentration of which was on the Dighty Water, near Dundee, where from there having been only a single mill in 1760, numbers had risen to seventeen by 1790¹⁶³.

With the mechanisation of flax spinning and the construction of spinning mills, coarse yarn production soared and the need for plash mills increased correspondingly. As most of these spinning mills were situated within the existing coarse linen region, the overall distribution of plash mills was little changed and continued unchanged throughout the remaining life of the Scottish linen industry (figure 16.6. In all, about fifty plash mills were built in Scotland during the period 1730 - 1830.

16.6



- 1 : Durie, A.J., "The Scottish Linen Industry, 1707-1775
with Particular reference to the Early History of the
British Linen Company" Edinburgh University PhD, 1973 10
- 2 : Gauldie, E. "Mechanical Aids to Linen Bleaching in
Scotland" Textile History, I 130 (No. 2, Dec. 1969)
- 3 : SRO NG1/1/1 8/11/1728
- 4 : McCutcheon, W.A. "Water Power in the North of Ireland"
TNS XXXIX 80 (1966-7)
- 5 : SRO NG1/1/2 7/5/1731
- 6 : SRO NG1/1/3 19/7/1734
- 7 : Ibid.
- 8 : SRO NG1/1/3 18/1/1734
SRO NG1/1/4 18/7/1735
- 9 : SRO NG1/1/18 18/3/1765
- 10 : McCutcheon, op.cit. 79
- 11 : Ibid.. 79
- 12 : Gauldie, op.cit., 133
- 13 : NLS Acc. 2933 Box 329 f.1.
- 14 : SRO NG1/1/12 13/12/1754
- 15 : SRO NG1/1/12 17/1/1755
- 16 : SRO NG1/1/16 22/1/1762
- 17 : SRO NG1/1/31 15/12/1802
SRO NG1/1/32 4/7/1810
SRO NG1/1/33 3/7/1813
- 18 : SRO GD128/3/1
SRO CS96/2072
- 19 : Gauldie, op.cit., 140
- 20 : McCutcheon, op.cit., 78
- 21 : Ibid.. 78

- 22 : Ibid., 78
- 23 : Gauldie, E. "Water-Powered Beetling Machines" TNS
XXX 125 (1966-7)
- 24 : SRO NG1/1/3 18/1/1734
- 25 : SRO NG1/1/3 19/7/1734
- 26 : Green, E.R.R. "The Industrial Archaeology of County
Down" Belfast, 1963 Cited by Gauldie op.cit. (1969) 139
- 27 : SRO NG1/1/11 12/7/1751
- 28 : SRO NG1/1/11 15/11/1751
- 29 : SRO NG1/1/11 24/1/1752
- 30 : NLS Acc 2933/330
- 31 : Durie, A.J. op.cit., 365-6
- 32 : Ibid., 366
- 33 : NLS Acc. 2933/330
- 34 : SRO NG1/1/16 22/1/62 Later withdrawn. See SRO NG1/1/18
27/3/1764
SRO NG1/1/17 4/2/1763
SRO NG1/1/17 5/8/1763
SRO NG1/1/17 16/7/1763
- 35 : SRO NG1/1/28 13/6/1792
- 36 : SRO NG1/1/34 8/7/1823
- 37 : SRO CS96/2072
- 38 : Gauldie, op.cit., (1969) 139
- 39 : SRO NG1/1/28 17/12/1794
- 40 : SRO NG1/1/29 20/5/1795; 17/6/1795; 20/1/1796
- 41 : Gauldie, op.cit., (1966-7) 126
- 42 : SRO NG1/1/34 19/6/1821
- 43 : Durie, A.J., op.cit., 366
- 44 : Gauldie, op.cit., (1969) 140-1
- 45 : SRO GD128/3/1

- 46 : Crawford, G. (revised Semple W.) "The History of Renfrewshire" Paisley 1782
- 47 : For a full account of the role of chemistry in bleaching see Clow, A. & Clow, N.L. "The Chemical Revolution" London 1952
- 48 : Ormiston, 1731; Tulloch, 1735.
- 49 : Kinchey, 1734
- 50 : Scottish Burgh Records Society "Extracts from the Records of the Burgh of Glasgow" vol. V (1718-38) Glasgow 1909 290
- 51 : Ibid., 290
- 52 : SRO NG1/1/1 8/11/1728
- 53 : SRO NG1/1/1 10/1/1729
SRO NG1/1/4 23/6/1738
- 54 : c.f. Perth, Irvine, Ednam, all SRO NG1/1/4 13/1/1738
- 55 : SRO NG1/1/4 23/6/1738
- 56 : SRO NG1/1/4 26/1/1739
- 57 : SRO NG1/1/9 10/6/1748
- 58 : SRO NG1/1/9 17/6/1748
SRO NG1/1/9 6/1/1749
- 59 : SRO NG1/1/9 27/1/1749
SRO NG1/1/11 23/11/1750
- 60 : SRO NG1/1/11 23/11/1750
- 61 : SRO NG1/1/10 12/1/1750
- 62 : SRO NG1/1/10 20/7/1750
- 63 : SRO NG1/1/11 23/11/1750
- 64 : SRO NG1/1/9 24/2/1749
- 65 : SRO NG1/1/9 24/2/1749
- 66 : SRO NG1/1/10 9/6/1749
- 67 : SRO NG1/1/11 23/11/1750

- 68 : SRO NG1/1/11 18/1/1751
- 69 : SRO NG1/1/11 8/2/51
- 70 : SRO NG1/1/11 15/11/51
SRO NG1/1/11 24/1/1752
- 71 : SRO NG1/1/12 19/1/1753
- 72 : SRO NG1/1/12 15/6/1753
- 73 : Durie, op.cit., 357
- 74 : SRO NG1/1/13 23/12/1756
- 75 : SRO NG1/1/12 16/11/1753
SRO NG1/1/20 20/1/1773
- 76 : SRO NG1/1/29 20/5/1795
SRO NG1/1/23 26/6/1782
- 77 : Durie, op.cit., 356-7
SRO NG1/1/16 22/1/1762
- 78 : SRO NG1/1/18 18/3/1765
- 79 : SRO NG1/1/12 13/12/1754
SRO NG1/1/19 17/1/1770
- 80 : SRO NG1/1/21 7/2/1776
SRO NG1/1/27 2/3/1791
- 81 : SRO NG1/1/12 26/12/1753
- 82 : SRO NG1/1/13 5/3/1756
- 83 : SRO NG1/1/20 17/2/73
- 84 : SRO NG1/1/21 2/7/77
SRO NG1/1/22 3/12/1777
- 85 : SRO NG1/1/22 3/12/77
SRO NG1/22 11/3/1778
- 86 : SRO NG1/1/18 14/3/1766
SRO NG1/1/18 24/3/1767
- 87 : OSA XVII 638 21/2/1785
- 88 : SRO NG1/1/5 18/1/1740 SRO 00128/3/1

- 89 : SRO NG1/1/20 15/12/1773
 SRO NG1/1/22 27/1/1779
 SRO NG1/1/26 8/8/1787
 SRO NG1/1/21 30/11/74
 SRO NG1/1/18 14/3/1766
- 90 : Clow & Clow, op.cit., 180
- 91 : SBRs Glasgow V 290
- 92 : SRO NG1/1/1 9/8/1728
- 93 : Durie, op.cit., 351
- 94 : SRO NG1/1/12 17/1/1755
 SRO NG1/1/12 1/12/1752
 SRO NG1/1/8 19/12/1746
- 95 : NSA X 1034
- 96 : SRO NG1/1/19 22/1/1772
- 97 : SRO NG1/1/20 26/1/1774
- 98 : Crawford, G. op.cit., 171, 267
- 99 : SRO NG1/1/11 3/1/1752
- 100 : SRO NG1/1/27 29/7/1789
 SRO NG1/1/27 2/12/1789
 SRO NG1/1/26 10/12/1788
 SRO NG1/1/25 14/11/1785
- 101 : SRO NG1/1/1 24/1/1729
- 102 : SRO NG1/1/16 21/1/1761
- 103 : SRO NG1/1/17 5/8/1763
- 104 : SRO NG1/1/18 24/3/1767
- 105 : SRO NG1/1/22 8/3/1780
- 106 : SRO NG1/1/25 22/6/1785
 SRO NG1/1/25 29/6/1785
 SRO NG1/1/24 21/2/1785
 SRO NG1/1/27 17/6/1789 SRO GD128/3/1

- 107 : SRO NG1/1/3 19/7/1734
108 : SRO NG1/1/2 7/5/1731
SRO NG1/1/4 18/7/1735
SRO NG1/1/21 7/2/76
109 : SRO NG1/1/32 6/7/1708
110 : SRO NG1/1/12 16/11/53
111 : SRO NG1/1/12 13/12/1754
Crawford, op.cit., 265
112 : SRO NG1/1/12 15/11/1754
113 : SRO NG1/1/12 17/1/1755
114 : SRO NG1/1/4 18/7/1735
115 : SRO NG1/1/12 2/8/1754
SRO NG1/1/11 3/1/1752
116 : SRO NG1/1/24 21/2/1785
117 : SRO NG1/1/35 29/6/1824
SRO NG1/1/16 31/7/1761
118 : SRO NG1/1/21 7/12/74
SRO NG1/1/12 1/12/1752
SRO NG1/1/12 13/7/1753
SRO NG1/1/31 11/12/1805
119 : SRO NG1/1/25 29/6/1785
SRO NG1/1/13 27/8/1756
SRO NG1/1/12 19/7/1754
SRO NG1/1/22 28/1/1778
SRO NG1/1/21 26/2/1777
SRO NG1/1/27 2/3/1791
120 : SRO NG1/1/21 26/2/1777
121 : SRO GD128/3/1 28/1/1768
122 : SRO NG1/1/1 10/1/29

- 122 : SRO NG1/1/4 26/1/1739
 123 : SRO NG1/1/4 28/6/1738
 SRO NG1/1/4 23/6/1738
 SRO NG1/1/4 12/12/1735
 124 : SRO NG1/1/11 3/1/1752
 SRO NG1/1/19 22/11/1769
 125 : SRO NG1/1/16 22/1/1762
 SRO NG1/1/16 22/1/1762
 126 : SRO NG1/1/18 26/7/1768

- 127 : Luncarty:
 SRO NG1/1/11 24/1/1752
 SRO NG1/1/13 14/11/1755
 SRO NG1/1/14 24/1/1749
 SRO NG1/1/18 27/3/1764

Deskford:

- SRO NG1/1/12 1/12/1752
SRO NG1/1/12 19/1/1753
SRO NG1/1/12 17/1/1755
SRO NG1/1/17 4/2/1763
SRO NG1/1/17 27/4/1763
SRO NG1/1/31 15/12/1802
SRO NG1/1/34 10/7/1821

Ormiston:

- SRO NG1/1/3 19/7/1734
SRO NG1/1/4 28/6/1738
SRO NG1/1/8 12/6/1747
SRO NG1/1/10 9/6/1749
SRO NG1/1/12 26/3/1753
SRO NG1/1/19 28/7/1768

- 128 : SRO NG1/1/4 23/6/1738

- 129 : SRO NG1/1/8 12/6/1747
- 130 : SRO NG1/1/10 12/1/1750
- 131 : SRO NG1/1/10 20/7/1750
- 131 : SRO NG1/1/12 24/11/1752
- 131 : SRO NG1/1/14 24/1/1759
- 132 : SRO NG1/1/16 23/1/1761
- 133 : SRO NG1/1/19 12/3/1771
- SRO NG1/1/20 1/12/1773
- 134 : SRO NG1/1/22 17/2/1779
- 135 : SRO NG1/1/32 6/7/08
- 136 : SRO NG1/1/23 26/2/1783
- SRO NG1/1/24 16/6/1784
- SRO NG1/1/24 23/6/1784
- 137 : SRO NG1/1/27 1/7/1789
- SRO NG1/1/27 8/7/1789
- SRO NG1/1/27 9/12/1789
- 138 : Durie, op.cit., 204
- 139 : Ibid., 349
- 140 : NLS Acc. 2933/350 Minute of the Court of Proprietors
of the British Linen Company, 7th September 1747
- 141 : Durie, op.cit., 351
- 142 : NLS Acc. 2933/350
- 143 : SRO NG1/1/11 3/1/1752
- 144 : Durie, op.cit., 366
- 145 : NLS Acc. 1933/350
- 146 : SRO NG1/1/12 19/1/1753 See also Clow & Clow, op.cit.
- 147 : Durie, op.cit., 367
- 148 : Mostyn Armstrong (Map of) The Lothians 1777
- 149 : See Scott, W.R. "Joint Stock Companies to 1700"
3 vols. Cambridge, 1910-12

- 150 : Devine, T.M. "Glasgow Merchants in Colonial Trade
1770-1815" Strathclyde University PhD thesis 1972
- 151 : Durie, op.cit., 366
- 152 : Gauldie, op.cit.
- 153 : SRO NG1/1/9 11/1/48
- 154 : SRO NG1/1/9 18/1/48
- 155 : SRO NG1/1/9 15/7/48
- 156 : SRO NG1/1/9 22/7/48
- 157 : SRO NG1/1/9 4/8/48
- 158 : SRO NG1/1/10 23/6/49; 21/7/49
- 159 : SRO NG1/1/10 12/11/50; 23/11/50
- 160 : SRO NG1/1/14 14/7/58
- 161 : Hay, G. "History of Arbroath" Abroath, 1876 406
- 162 : NLS Acc. 2933/330
- 163 : OSA V 218 Mains of Fintry, Angus

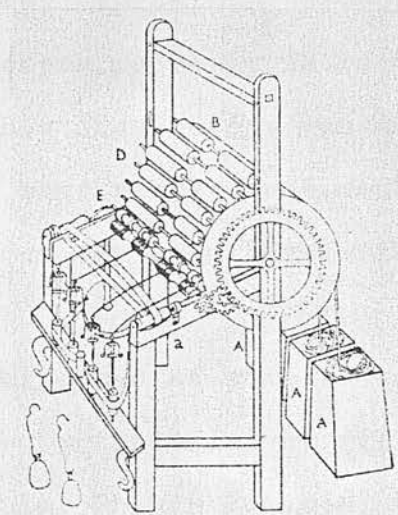
FLAX SPINNING MILLSTechnology

Much attention has been given by historians to three inventions which revolutionised the cotton spinning industry in the late 18th century: Hargreaves' spinning jenny and Arkwright's water frame of 1769 and Crompton's mule of 1779¹. While the cotton industry was of undoubted importance in Scotland, as in England, only limited emphasis has been placed on the invention which led to the mechanisation of spinning in Scotland's other major textile industry, linen.

Substantial quantities of flax were already being spun by hand in Scotland when, in 1787, two Darlington men, Kendrew, an optician and Porthouse, a clockmaker, invented and patented a machine to spin flax² (figure 17.1). In the same year Messrs. Walters, Sim & Thom, threadmakers, obtained a licence and machinery from Kendrew and Porthouse which they used to establish an eight-frame, three-storey spinning mill on the Haugh of Bervie, Kincardineshire, with a view to producing yarn for thread³.

During the late 1787 and 1788 experiments with the machine were carried out in a former corn mill at Brighton, Angus, to ascertain its usefulness in producing yarn for Osnaburgs, the coarse staple cloth of eastern Scotland. The experiments proved successful, and in 1789 work started on a new four, or possibly five-storey mill nearby⁴. In November 1790 the proprietors attempted to recoup some of their costs by petitioning the Board of Trustees, but

17.1



despite a favourable report, the £300 which the Board had promised had to be forfeited on the grounds that the machinery was patented⁵. A few of the later mill-spinners attempted to circumvent this denial of funds by constructing, or claiming to have constructed, machinery of their own design. Neilson, Greenhill & Co. of Kirkland Mill, Fife, made such a claim in 1791, but were denied aid for refusing to make their invention available to the public⁶. A similar claim was made in 1794 by Alexander Aberdeen & Co., owners of a mill at Letham, near Arbroath. Although they promised to allow public access no reply is recorded to the Board's query as to just how free access was to be⁷. Either or both machines may have simply been modifications of Arkwright machinery, or may even have infringed on the Kendrew & Porthouse patent. As the latter machine was of simple design, it could be readily constructed or modified by millwrights. At Brechin, for example, Thomas Jamison, "a clever workman, but an unsteady man", built the machinery for a four-frame mill in 1796⁸. However, despite the enthusiasm shown in the 1790's, the Kendrew and Porthouse spinning frame had a major defect. According to Gauldie "hand spinners of flax had been accustomed to moisten their flax as they worked, to keep it flexible"⁹. Since the Kendrew and Porthouse machine spun flax dry, the yarn which it produced was brittle and subject to frequent snapping. The fault was diagnosed at an early stage¹⁰ and although a form of wet spinning was developed in France, c. 1800,

it was not until 1825 that James Kay of Preston, Lancashire, patented a wet spinning process¹¹.

Flax heckling, a process similar to carding in wool or cotton manufacture (cf.), separated the "line", or long fibres from the "tow", or short fibres. The latter, once separated, could be carded and spun like cotton and at least one tow carding mill was built on the River Carron in Dumfries-shire.¹² In some cases individual mills specialised in tow spinning, some moving to tow after the difficulties of spinning "line" became apparent. Heckling had been mechanised by the 1820's, but for the most part it was still performed by hand in 1830, skilled hecklers having an exalted status similar to that once enjoyed by weavers.

Competition from Steam

Many of the early flax spinning mills had been badly sited, necessitating the later addition of auxiliary steam engines to supplement water wheels during dry spells. At Kinghorn Fife, three flax and cotton spinning mills had been erected on the outflow from a small loch. Within a year or so it was realised that not only had the fall been underestimated but also that the loch would soon be drained. At one of the mills a colliery engine was installed, presumably to pump back water, but it proved so troublesome that it had to be abandoned. Boulton and Watt engines were later added to the other mills, with greater success¹³. At Glamis, Angus, auxiliary steam-power was installed in 1820¹⁴ and by 1834 twelve of the thirty-six mills surveyed by the Factory Commission were using auxiliary steam engines

while at many of the remaining mills owners complained of seasonal variations in water supply¹⁵. It should be borne in mind, however, that the survey was being carried out with a view to introducing a shorter working day, so the claims may not have been entirely genuine. Some of the same mills which ostensibly suffered from water shortages in the 1830's continued to increase their exploitation of water-power until the 1860's, without any resort to steam (Chapter 29 p. 766).

At Dundee, Arbroath and Kirkcaldy, towns with very little exploitable water-power, mills powered entirely by steam were built. During the 1790's three or four such mills were built in Dundee but with limited success and, although others were tried in the 1800's and 1810's, it was not until the 1820's that steam became a serious competitor to water-power¹⁶. Steam-power was about to be introduced in Fife c. 1800¹⁷ but it was apparently not until 1807 that the first steam-powered mill was built, at Kirkcaldy. The first steam-powered mill at Arbroath was established c. 1806¹⁸.

During the 1820's no less than twenty-six steam mills were built in Dundee and the first comprehensive figures, those for 1838, show Dundee in a commanding position, with Kirkcaldy and Arbroath taking second and third places. Nevertheless, water-power still accounted for more than thirty per cent of the power used in Scottish flax spinning mills¹⁹. The results of the 1838 survey are shown on figure 17.2.

Distribution and Chronology

As has already been noted, the first Scottish flax spinning

17.2

					MOVING POWER.					MOVING POWER.				
					STEAM.	WATER.				STEAM.	WATER.			
					No. of Engines and Horse Power.	No. of Wheels and Horse Power.	Together.			No. of Engines and Horse Power.	No. of Wheels and Horse Power.	Together.		
AYRSHIRE:														
Kilbirnie:														
Flax mills	-	1	-	-	20	-	-	-	20					
Engines and wheels	-	-	-	-	1	-	-	-	1					
TOTAL mills	-	1	-	-	60	-	-	-	60					
TOTAL engines & wheels	-	-	-	-	3	-	-	-	3					
Beith:														
Flax mills	-	2	-	-	26	-	-	-	26					
Engines and wheels	-	-	-	-	2	-	-	-	2					
ABERDEENSHIRE:														
Aberdeen:														
Flax mills	-	4	-	-	423	200	-	-	628					
Engines and wheels	-	-	-	-	10	3	-	-	13					
TOTAL mills	-	4	-	-	925	533	-	-	1,458					
TOTAL engines & wheels	-	-	-	-	19	10	-	-	29					
EDINBURGHSHIRE:														
Malleny:														
Flax mills	-	2	-	-	30	30	-	-	60					
Engines and wheels	-	-	-	-	1	2	-	-	3					
Musselburgh:														
Flax mills	-	2	-	-	61	-	-	-	61					
Engines and wheels	-	-	-	-	2	-	-	-	2					
Leith:														
Flax mills	-	1	-	-	30	-	-	-	30					
Engines and wheels	-	-	-	-	1	-	-	-	1					
Prestonhohn:														
Flax mills	-	1	-	-	55	30	-	-	85					
Engines and wheels	-	-	-	-	2	1	-	-	3					
Mills unoccupied -					see									
FIFE:														
Dunfermline:														
Flax mills	-	4	-	-	56	12	-	-	68					
Engines and wheels	-	-	-	-	3	1	-	-	4					
Kinghorn:														
Flax mills	-	3	-	-	103	13	-	-	116					
Engines and wheels	-	-	-	-	5	3	-	-	8					
Kirkcaldy:														
Flax mills	-	10	-	-	139	-	-	-	139					
Engines and wheels	-	-	-	-	11	-	-	-	11					
Dysart:														
Flax mills	-	1	-	-	-	20	-	-	20					
Engines and wheels	-	-	-	-	-	1	-	-	1					
Leslie:														
Flax mills	-	5	-	-	14	122	-	-	136					
Engines and wheels	-	-	-	-	1	6	-	-	7					
Edonbank:														
Flax mills	-	1	-	-	8	12	-	-	20					
Engines and wheels	-	-	-	-	1	1	-	-	2					
Falkland:														
Flax mills	-	2	-	-	-	10	-	-	10					
Engines and wheels	-	-	-	-	-	2	-	-	2					
Kettle:														
Flax mills	-	1	-	-	-	6	-	-	6					
Engines and wheels	-	-	-	-	-	1	-	-	1					
MARKING:														
Flax mills	-	3	-	-	-	107	-	-	107					
Engines and wheels	-	-	-	-	-	5	-	-	5					
TOTAL mills	-	3	-	-	-	116$\frac{1}{2}$	-	-	116$\frac{1}{2}$					
TOTAL engines & wheels	-	-	-	-	-	7	-	-	7					
Leven:														
Flax mills	-	6	-	-	44	110	-	-	154					
Engines and wheels	-	-	-	-	3	5	-	-	8					
Largo:														
Flax mills	-	1	-	-	14	15	-	-	29					
Engines and wheels	-	-	-	-	1	1	-	-	2					
Cupar:														
Flax mills	-	5	-	-	44	59	-	-	102					
Engines and wheels	-	-	-	-	3	4	-	-	7					
Dairsie:														
Flax mills	-	2	-	-	-	26	-	-	26					
Engines and wheels	-	-	-	-	-	2	-	-	2					
Pitscottie:														
Flax mills	-	1	-	-	8	26	-	-	34					
Engines and wheels	-	-	-	-	1	2	-	-	3					
Blebo:														
Flax mills	-	1	-	-	8	14	-	-	22					
Engines and wheels	-	-	-	-	1	1	-	-	2					
Mills unoccupied					3									
LANARKSHIRE:														
Glasgow:														
Flax mills	-	2	-	-	40	-	-	-	40					
Engines and wheels	-	-	-	-	2	-	-	-	2					
RENFREWSHIRE:														
Greenock:														
Flax mills	-	2	-	-	-	100	-	-	100					
Engines and wheels	-	-	-	-	-	2	-	-	2					
TOTAL mills	-	2	-	-	-	118	-	-	118					
TOTAL engines & wheels	-	-	-	-	-	3	-	-	3					
Port Glasgow:														
Flax mills	-	1	-	-	92	-	-	-	92					
Engines and wheels	-	-	-	-	2	-	-	-	2					
Mills unoccupied					-									
LINLITHGOWSHIRE:														
Blackburn:														
Flax mills	-	1	-	-	16	16	-	-	32					
Engines and wheels	-	-	-	-	1	1	-	-	2					

MOVING POWER.					MOVING POWER.				

mill was built near Inverbervie, Kincardineshire, in 1787 and the second at Brighton, Angus, in 1788. From this time onwards almost every mill of this type was to be built in east-central Scotland (figure 17.3). There were several reasons why this should be the case. The east of Scotland was already well established as the locus of coarse linen manufacture; the dry process spinning of the Kendrew and Porthouse machine was better suited to these products than to the finer textiles of the west. Even before the mechanisation of spinning home-grown flax had failed to meet demand and additional supplies had to be imported from the Baltic and elsewhere; the east of Scotland was well placed in relation to these sources. Added to this, there were already merchants dealing in flax and manufacturers giving out work to spinners and weavers. Their capital, access to raw materials and control of the existing labour force put them in a good position to utilise the new flax spinning machinery. All in all, the east of Scotland was the obvious area for the development of mechanised flax spinning.

One negative aspect also contributed to the concentration of flax spinning mills in east-central Scotland: in the west, linen production was already in decline and a new staple, cotton, had absorbed labour, capital and the best water-power sites.

Such was the consistency with which the industry remained centred on one area, that there is little that can be said of changes in distribution within the period 1787 - 1830. The first spate of mills, about thirty or so, built before



1800, were widely scattered, with little noticeable nucleation. Some, such as Kirkland and Kinghorn, in Fife, and West Barns, in East Lothian, combined flax with cotton spinning²⁰. Some were unwisely sited in relation to raw materials or, as has already been noted, to water-power. Up until 1800 the influence of steam-powered mills on the survival of water-powered ones was negligible. By 1800 much of the euphoria of the previous decade had evaporated and between that date and 1820 fewer mills were established than had been during the previous thirteen years. Among the newer mills there was a tendency to utilise rivers offering adequate water-power within reasonable reach of ports and thereby raw materials, notably the Erich in Perthshire, the Esk, Lunan and Dighty in Angus and the Leven and Eden in Fife. Although there was a move towards larger mills, this was not a universal trend: Lornty Mill, Blairgowrie, built in 1814, had only four spinning frames²¹. As yet, steam-power still offered little opposition. The 1820's brought a revival in building with as many mills built during that decade as in the previous two. By this time nucleation was becoming apparent and competition from steam was beginning to be felt. Once the use of steam-power and flax spinning machinery had been mastered, port based mills, at Dundee, Arbroath, Montrose or Kirkcaldy were much better placed than water-powered mills inland and, while the cost of coal had to be borne by steam-powered mills, they at least were untroubled by fluctuations in water supply. Some country mills were forced to close while others, by installing auxi-

liary steam-power, were still handicapped by the additional cost of carrying coal overland. For well sited mills, however, the relative cheapness of water-power was enough to guarantee their survival, and the construction of new mills after 1830²². Even in 1838 water-power was still competing successfully with steam (figure 17.2). In all, about ninety water-powered flax spinning mills had been built in Scotland by 1830. An additional twenty or so mills, mostly built in the 1830/s, will be dealt with in Section Three.

Sources of Finance

The Landowner

For Scottish landowners the prospect of establishing a flax spinning mill offered few attractions. The textile mills which they had been building since 1730 were generally on a small scale, both physically and in terms of capital investment; they utilised local raw materials, complemented rather than competed with agriculture and were of little or no detriment, aesthetically or economically, to the estate. Flax spinning mills failed to satisfy any of these criteria: they were physically large, required substantial capital investment, competed with agriculture for labour and, at a time when landowners were already becoming disenchanted with industrialisation, might well have seemed detrimental aesthetically in terms of the building itself and the influx of workers, or economically in terms of the work which it took away from hand-spinning and the inflationary effect on farm and estate workers' wages.

Besides all these drawbacks, the landowner could never hope to match the business acumen, existing contacts and access to capital enjoyed by merchants and manufacturers. On the other hand the landowner, by joining a partnership or allowing others to build mills on his land, could find some benefits. Although the high wages offered by spinning mills drew labour away from the land, the presence of a large industrial workforce ensured a ready market for agricultural produce. While spinning mills took work from spinners it gave it back to weavers. By augmenting the estate's rental, the establishment of a spinning mill might well be to its benefit, economically or even aesthetically, provided that overall control of development rested with the landowner, who could make it the nucleus of an existing or projected planned village.

The earliest case of involvement by a landowner is also the most interesting. The Brighton Mill of 1789, although financed and run by Dundee interests headed by the mathematician, James Ivory, also involved the landowner, William Douglas. Besides making a corn mill available for experiments he built the village of Douglastown to house spinning-mill workers²³. When, in 1803, the company was disbanded, Douglas paid off its debts and in the following year bought the mill at a public sale. He continued to run the mill until 1808 when he took in partners at £800 each. Some seven years later poor trade and bad debts forced the mill to close once more; Douglas again paid off its debts and ran the mill himself until 1817, when he finally withdrew. The mill and the village were advertised for sale, initially at an upset price of

£3,000, subsequently at £2,000. It was eventually bought and continued to operate until the mid-1830's, when it finally closed down²⁴.

Douglas was much more typical of the 18th than the 19th century landowner in his dedication, probably misguided, to a favourite project.

The only other landowner who is known to have been actively involved in flax mill spinning was George Dempster of Dunnichen. While Dempster was better known for his exploits in the cotton industry (p. 468) he was a member of the partnership which built a flax mill alongside the cotton mill at Stanley, Perthshire²⁵. He may also have been involved in either or both of the spinning mills operating at his village of Letham in 1813²⁶.

Merchants and Manufacturers

In contrast to the passive role of the landowners, that of the merchants and manufacturers was central to the development of flax spinning mills.

Some reference has already been made to the advantages enjoyed by merchants and manufacturers when it came to establishing such mills (p. 359). In addition, it should be said that spinning was a major cost component in the manufacture of flax, offering an incentive to mechanise the process and thereby increase profits or undercut competitors. Although large sums might be required to establish a flax spinning mill, initial losses could be offset by profits from other processes in textile manufacture.

Of those merchants and manufacturers involved in mill

building, the majority already had close links with the textile industry. Mark Stark, who founded Brucefield Mill, Dunfermline and Prestonholm Mill, Midlothian, both in 1793, had previously run a bleachfield at the former site²⁷. The Baxters at Dundee and Alexander Aberdeen & Co. at Arbroath were already linen manufacturers when they built their spinning mills, while two of the partners in Grandholm Mill, Aberdeenshire, had backgrounds in the bleaching and woollen industries (p. 371). While most merchants and manufacturers were based at coastal towns, the need for water-power led them to build mills miles inland. Thus a Montrose company built their mill four miles inland at Logie²⁸; Baxters and Neilsons, both from Dundee, built mills at Glamis and Kirkland respectively²⁹. Kirkcaldy merchants and manufacturers, such as John Fergus built their mills to the north, on the River Leven³⁰. One important inland centre, Forfar, was also very deficient in water-power; James Laird & Co., manufacturers there, built a mill five miles away on the Esk at Murthill³¹. Despite the creation of rural spinning mills, the yarn produced there still went back to the manufacturers' town bases and particularly to Dundee. In many cases it was a struggle to find even enough local labour for the spinning mill itself, so there was little prospect of weaving taking place there too. Furthermore, the organisation of the industry was still centred on the towns and ports as the move back to them showed once steam-power became practicable. Even Blairgowrie, a growing community with an established weaving population, sent yarn to Dundee³².

Tenants and Artisans

Bearing in mind the need for capital, knowledge of the trade and control over other stages in manufacture, it is hardly surprising that very few tenants or artisans were able to build flax spinning mills. The two rare examples described below show the contrasting fortunes of a weaver and a millwright.

James Smith, the eldest son of a millwright, trained and worked as a weaver before giving it up at the age of seventeen to work in his mother's meal shop. Four years later he decided to build a flax spinning mill at Strathmartine, Angus, on land tenanted by his uncle. Tradesmen's bills for the construction of the mill came to £407, but for the most part no written contracts were entered into. The mason, who was due £67 received only £40, the remainder of his account being paid as sixteen bolls of meal, a quantity of sugar and some cheese. The millwright also received part of his payment in kind. Other tradesmen received part of the money due to them but Smith was unable to pay their accounts in full and only thirteen months after construction had started his assets were sequestrated³³.

In contrast David Grimond enjoyed considerable success. The Grimond family had occupied a lint mill on Lornty Burn, north of Blairgowrie: Charles Grimond was granted £15 in 1803 to repair the lint mill of Lornty and build a shed³⁴. This mill was almost certainly that in which David Grimond, a millwright by trade, installed four spinning mills in 1814, although McDonald claims that

the mill was built from scratch³⁵. The profits from the mill, about £5 - £6 per week, may have been re-invested in a second mill, Brooklinn, which David Grimond built on the tail lade of Lornty Mill, probably in 1820³⁶. At one time or another the Grimond family controlled four of the twelve mills in the Blairgowrie area³⁷. As with William Douglas among landowners, David Grimond was very much the exception to the rule among tenants and artisans. With very few exceptions Scottish flax spinning mills were the work of merchants and manufacturers.

The Board of Trustees

Before leaving the subject of mill financing, something should be said of the role of the Board of Trustees, if only to illustrate the way in which developments had overtaken it.

Reference has already been made to the Board's reluctance to provide financial backing for flax-spinning mills, on the grounds that the machinery was patented (p. 356).

There were other grounds on which the Board refused help. It had seldom given backing to large-scale projects, the raw material was imported and the mechanisation of the process deprived hand-spinners of their livelihood.

By the mid-1790's merchants and manufacturers had accepted that the Board was not going to provide help; in any case, it is doubtful whether they either wanted or needed the small amount of aid which the Board could have given, had it wished to.

The mid-1790's also saw the emergence of a long-standing point of contention between the mill-spinners and the

Board of Trustees. In July 1795 eight mill-spinners, including Robert Fall & Co., merchant owners of West Barns Mill, petitioned the Board for the abolition of the Act under which reels of yarn were confiscated for containing too little³⁸. The regulation, which had originally been introduced to prevent fraud, was easy to comply with when small quantities were being spun by hand, but almost impossible under mill-spinning. However, the Board was adamant: "this application cannot upon any account be listened to"³⁹. In 1800, after a second petition, this time from mill-spinners in Fife, a committee of enquiry was appointed, which eventually found in their favour⁴⁰. Despite the ruling, the Act continued to be enforced. During 1806 the Board's inspector was refused access to at least one mill and by 1808 a group of mill-spinners were preparing to lobby Parliament for the Act's abolition⁴¹. The battle dragged on until finally, in 1823, the Board's powers of inspection, including that of linen yarn, were abolished⁴².

As far as flax-spinning was concerned, the Board had outlived its usefulness. The protection, guidance and support which it offered were of great value to the small-scale manufacturer of the 18th century, but in an age of large-scale capitalist mill-spinners such activities, by a group largely made up of landowners and members of the legal profession, were seen as being restrictive and obsolete.

Had the Board been more flexible in its approach, it could have found a useful role in controlling working conditions.

Indeed, part of the reluctance among mill-spinners to allow inspection might have been due to the abysmal conditions under which their employees worked. As it was, the Factory Commission and the Royal Commission on the Labour of Children in Factories assumed this role from the 1830/s onwards and it is only through their work that we know just how bad these conditions could be.

The Workforce

The mechanisation of flax spinning brought about important changes in the distribution, quantity and quality of work. Prior to mechanisation spinning had been performed by individuals at home, or occasionally in small workshops. Although manufacturers already had some control over those employed, workers, generally female, were free to work their own hours and lived in communities scattered over a wide area. The effect of mechanisation was to concentrate spinning in a relatively few localities, denying work to those in many other localities where spinning had formerly been performed. From Meigle parish, Perthshire, it was reported in the New Statistical Account that machinery had put an end to hand-spinning and that old women in particular had been reduced to poverty for want of work⁴³.

On the other hand the increase in output engendered by mechanisation created more demand for weavers and in several instances weaving re-absorbed some of the labour deprived of spinning work. In Collace parish, Perthshire, according to the New Statistical Account, the spinning wheel had been entirely superseded and spinsters had taken up the loom, using yarn which agents brought by cart from

Dundee⁴⁵. The same changeover had occurred in the Forfar area by 1812⁴⁵.

While the mechanised spinning industry was less labour intensive, there were still problems in recruiting workers. An average mill might need about forty or fifty workers, and larger ones a hundred or more. The dependence upon water-power meant that mills were often built in areas with only a scattered rural population, much of it already employed in agriculture or weaving. There are also reasons for believing that there was a reluctance to work in such unpleasant, strictly regulated conditions. The evidence given to the Royal Commission on the Labour of Children in Factories not only casts some light on these conditions, but also shows the ways in which a labour force was found. In some cases children as young as five years of age were hired for a few months or several years. Orphans from charitable institutions in Edinburgh and Perth were sent to work in mills, sharing bothies with adolescent female employees. To fulfil a certain work quota, a working day, nominally thirteen or fourteen hours, might be extended up to twenty-one hours during low water. Clocks were removed from within the mill and workers were locked in⁴⁶. Generally speaking, workers in country mills suffered longer hours and poorer living conditions than those in towns. Because of the isolation of many mills it was difficult to find alternative employment. With the exception of children the majority of mill employees were young women, the same women who might otherwise have worked at hand spinning. The writer of the Old Statistical Account for Dron parish, Perthshire, com-

plained of the shortage of female servants brought about by the increase in linen manufacture and the recent introduction of spinning⁴⁷. There is also some slight evidence of people displaced from the land finding employment in spinning mills.

Through time conditions in spinning mills improved. At Trottick Mill, Angus, for example, the mill owner ran a school which child employees could attend during working hours⁴⁸. The practice of accommodating workers in bothies began to give way to building houses as the scale of mills increased. Besides the example at Douglstown (p. 362), villages grew up at Haugh Mill, Fife and at Craigo and Logie, Angus⁴⁹. At Prinlaws, Fife, a village created to house bleachfield and spinning mill workers contained seven hundred and sixty inhabitants by the mid-1840's. The houses, each with its own garden, were "neatly built, and ornamented with shrubs and evergreens"⁵⁰. At Blairgowrie some mill workers lived beside the mills and others at the existing communities of Blairgowrie and Rattray⁵¹.

A Scottish Flax-spinning Mill

Grandholm Mill. Aberdeen

On 20th February 1792 the firm of Leys & Co. entered into an agreement with John Paton of Grandholm, under which the company cut a lade over a mile in length to carry water from the River Don to a projected bleachworks and flax-spinning mill⁵². The three partners, Thomas Leys, Alexander Brebner and James Hadden, had previous contacts with the textile industry. Leys was a member of the family which, in 1749, had established a bleachfield at

Gordon's Mills under the firm of Leys Still & Co., later Leys, Masson & Co.⁵³ Alexander Brebner was his brother-in-law and James Hadden was the son of Alexander Hadden, a hosiery merchant in Aberdeen and a woollen manufacturer at Gordon's Mills and Garlogie⁵⁴.

The original flax-spinning mill stood seven storeys high and contained three hundred and eighty-six windows⁵⁵; two water wheels developed eighty horse power⁵⁶. To facilitate access the company built bridges over the River Don and the Aberdeenshire canal⁵⁷. In 1805 the water supply was augmented by the construction of a dam across the Don, at the intake to the lade, thereafter additional wheels were installed to give a further forty-three horse power⁵⁸. A fireproof wing was added to the mill in 1812⁵⁹ and in all nearly £30,000 was spent on modifications to the mill between 1805 and 1820⁶⁰.

According to Kennedy, writing in 1818, the mill contained two hundred and forty spinning frames, producing 10,000 spindles of yarn per week. Part of the machinery was used to twist yarn for coloured thread. The heavy yarns were sent south for weaving, mostly to Fife and Angus, while the rest of the yarn was woven by the Company⁶¹.

An additional fireproof building, for heckling by power, was built in 1822-3; a third building, for weaving and tow carding, was constructed in 1826 and extended in 1830⁶². All this additional machinery put a strain on the available water power, for although the company had one hundred and fifty horse power at its disposal, it had become involved in expensive litigation over water rights, which started in 1816 and dragged on for many years thereafter, eventually

to be settled by compromise⁶³. With these problems to consider, plus the variable flow of the River Don, the company, like several others, installed auxiliary steam engines of fifty and sixty horse power, one of which ran in tandem with one of the water wheels during low water⁶⁴. The mill continued to operate long after 1830, eventually being used as a woollen mill⁶⁵.

Summary

With the mechanisation of spinning, the Scottish linen industry made a further move from being primarily a domestic industry dispersed over a large area, to a factory industry concentrated in relatively few localities. The move towards a more capital intensive industry, which had started with mechanised flax scutching and which had developed further with the mechanisation of bleaching, took a major step forward. In those areas where mills were built, new villages were created and others expanded to house both mill workers and the additional workforce required in weaving and bleaching. The need for commercial skills and the large amount of capital required to establish and run a spinning mill precluded involvement by the tenants and artisans who had contributed to the industry at earlier stages; landowners, lacking capital, expertise or, for that matter, interest, were also excluded. In almost every case the initiative to build flax spinning mills came from merchants and manufacturers, working individually or collectively, and such was their power and influence that they could ignore or even overrule the Board of Trustees, the body which had supported and guided the industry during its earlier days.

The adoption of fixed quotas of production, in a highly competitive market, was in conflict with the variable capabilities of water power and led initially to the imposition of excessively long hours and eventually to the introduction of steam power either as a supplement or as an alternative. While the better sited water-powered mills continued to function up to and beyond 1830, the industry had already become primarily urban by that date, leading to a further concentration of population and a decline in rural industry. The Age of Water Power was coming to an end. The Age of Steam had already begun.

1. PRO 201/1/27 17/1/20; 19/1/21; 26/1/21
2. PRO 201/1/27 2/2
3. PRO 201/1/28 11/6/24
4. Black, J.B., "The History of Birchen to 1864" 2nd Edition, Edinburgh 1867 72
5. Orlidge, R. (Ed) "The Dundee Textile Industry 1790-1864" PRO 4th Series VI (1967) ix
6. For example, PRO 201/1/27 17/1/20, 19/1/21, 26/1/21
7. Warden, op.cit. 492-3
8. PRO 201/1/27 29/6/24
9. Warden, op.cit. 510
10. PRO 201/1/27 17/1/20
11. PRO 201/1/27 17/1/20. Replies by Manufacturers to Queries
12. Warden, op.cit. 508-9, 592
13. Townsend, J., "General View of the Agriculture of the County of Fife" Edinburgh, 1800 307
14. Warden, op.cit. 565
15. PRO 201/1/27 17/1/20

- 1 : See Chapter 20 pp 461-2
- 2 : Mann, J.de L.. in Singer, C.. Holmyard. E.J.. Hall.
A.R. & Williams, T.I. (Eds) "A History of Technology"
5 vols., Oxford, 1956-9 IV 291-2
- 3 : Warden, A.J., "The Linen Industry Ancient & Modern"
London 1864 489-90
OSA XIII 4
- 4 : Warden, op.cit., 511
NSA XI 218
- 5 : SRO NG1/1/27 17/11/90; 19/1/91; 26/1/91
- 6 : SRO NG1/1/27 2/2/91
- 7 : SRO NG1/1/28 11/6/94
- 8 : Black, D.D. "The History of Brechin to 1864" 2nd
Edition, Edinburgh 1867 272
- 9 : Gauldie, E. (Ed) "The Dundee Textile Industry 1790-
1885" SHS 4th Series VI (1969) xx
- 10 : See, for example, OSA V 218 on Trottick Mill, Angus
- 11 : Mann, op.cit., 292-3
- 12 : SRO NG1/1/35 29/6/24
- 13 : Warden, op.cit., 510
- 14 : NSA XI 348
- 15 : PP 1834 XIX 80180 Replies by Manufacturers to Queries
- 16 : Warden, op.cit., 588-9. 592
- 17 : Thomson, J. "General View of the Agriculture of the
County of Fife" Edinburgh, 1800 307
- 18 : Warden, op.cit., 565
- 19 : PP 1834 XIX 82-3

- 20 : Butt, J. "Valuation of Scottish Cotton Mills by Sun
Fire Insurance Office c.1795" EcHR 2nd Series.
XXIII (1970) 262-3
- 21 : MacDonald, J.A.R., "A History of Blairgowrie"
Blairgowrie, 1899 168
- 22 : See Chapter 29
- 23 : Although Warden attributes the village to James Ivory
& Co., an earlier source, the New Statistical Account
names Douglas himself as its founder NSA XI 225
- 24 : Warden, op.cit., 511-3
- 25 : OSA XVIII 515
- 26 : Headrick, J. "General View of the Agriculture of
Forfarshire" Edinburgh, 1813 210-1
- 27 : OSA XIII 433
SRO GD45/16/450
SRO NG1/1/18 8/12/67
- 28 : NSA XI 267
- 29 : Gauldie, op.cit., xx-xxi
- 30 : SRO NG1/1/19
PP 1834 XIX 66-7
John Fergus & Son, manufacturers in Kirkcaldy, esta-
blished a bleachfield at Tyrie in 1772 and a flax-
spinning mill at Leslie before 1834. John Fergus
& Sons also had a cotton mill at Kinghorn in 1796
Butt, op.cit., 263
- 31 : SRO CS96/767
- 32 : NSA X 921
- 33 : SRO CS96/419
- 34 : SRO NG1/1/31 6/7/1803

- 35 : MacDonald, op.cit., 168. A lintel bears the date
1755, possibly that of the original lint mill.
- 36 : PP 1834 XIX 164 1820 is the second of two dates
given by Grimond. The first, 1815, ties in with the
commencement of spinning at Lornty.
- 37 : Ibid., 165 Oakbank Mill
MacDonald, op.cit., 169 Ashbank Mill
- 38 : SRO NG1/1/29 8/9/95
Act 13th Geo 1st Cap. 26
- 39 : Ibid.,
- 40 : SRO NG1/1/30 28/5/1800 4/2/1801
SRO NG1/1/32 9/7/1806
- 41 : SRO NG1/1/32 9/7/1806; 24/2/1808
- 42 : Warden, op.cit., 472
- 43 : NSA X 236
- 44 : Ibid., 215-6
- 45 : Headrick, op.cit., 189
- 46 : PP 1832 XV 338-92 Royal Commission on the Labour
of Children in Factories
- 47 : OSA IX 466
- 48 : PP 1832 XV 364
- 49 : Logie, Craigo: Butt, J. "The Industrial Archaeology
of Scotland" Newton Abbot, 1967 62
Haugh Mill: Lewis, S. "Topographical Dictionary of
Scotland" 2 vols London 1846 I 536
- 50 : Lewis, op.cit., II 170
- 51 : Wilson, J.M. (Ed) "The Imperial Gazetteer of Scotland"
2 vols. Edinburgh, London & Dublin N.D. (c.1865)
I 174-5, II 645
- 52 : Morgan, P. "Annals of Woodside and Newhills" Aberdeen 1886 58

- 53 : Ibid., 58
- 54 : Ibid., 65, 67
- 55 : Ibid., 59
- 56 : Ibid., 63
- 57 : Ibid., 59
- 58 : Ibid., 63
- 59 : PP 1834 XIX 10
- 60 : Morgan, op.cit., 64
- 61 : Kennedy, W. "Annals of Aberdeen" 2 vols London 1818
II 199-200
- 62 : PP 1834 XIX 10
- 63 : Morgan, op.cit., 59-63
- 64 : PP 1834 XIX 10-12
- 65 : Butt, op.cit., (1967) 200

CONCLUSION

Unlike any other type of 18th century textile mill, the Scotch mill and its technology were by no means new to Scotland (Chapter three). It is therefore doubtful whether any technical advances were made in the years immediately after 1730. By mid-century however, there is some indication of attempts to improve wool mills by utilising English designs.

A group of Glasgow merchants, with a manufactory at Carrington, petitioned the Board of Trustees in 1745 for help in building an English-style wool mill, claiming that a "perfect fulling mill" was "377 or utterly unknown in this country". Eventually, in 1754, a mill was built at a cost of £180², but in the meantime a second mill, at Radding-

WOOLLEN MILLS 1730 - 1785Introduction

The century between 1730 and 1830 saw the transformation of the Scottish woollen industry from one in which most of the processes in manufacture were performed by hand to one in which almost all were performed by machine. Within the period however, it was not until 1785 that most of this mechanisation took place and while the industry prior to this date shows indications of the way in which it was to develop thereafter, it was in many other respect little different from that of the late 17th century. For this reason and because of the sheer scale of the industry between 1730 and 1830, it is convenient to consider the periods before and after 1785 in two separate chapters.

Technology

Unlike any other type of 18th century textile mill, the waulk mill and its technology were by no means new to Scotland (Chapter three). It is therefore doubtful whether any technical advances were made in the years immediately after 1730. By mid-century however, there is some indication of attempts to improve waulk mills by utilising English designs.

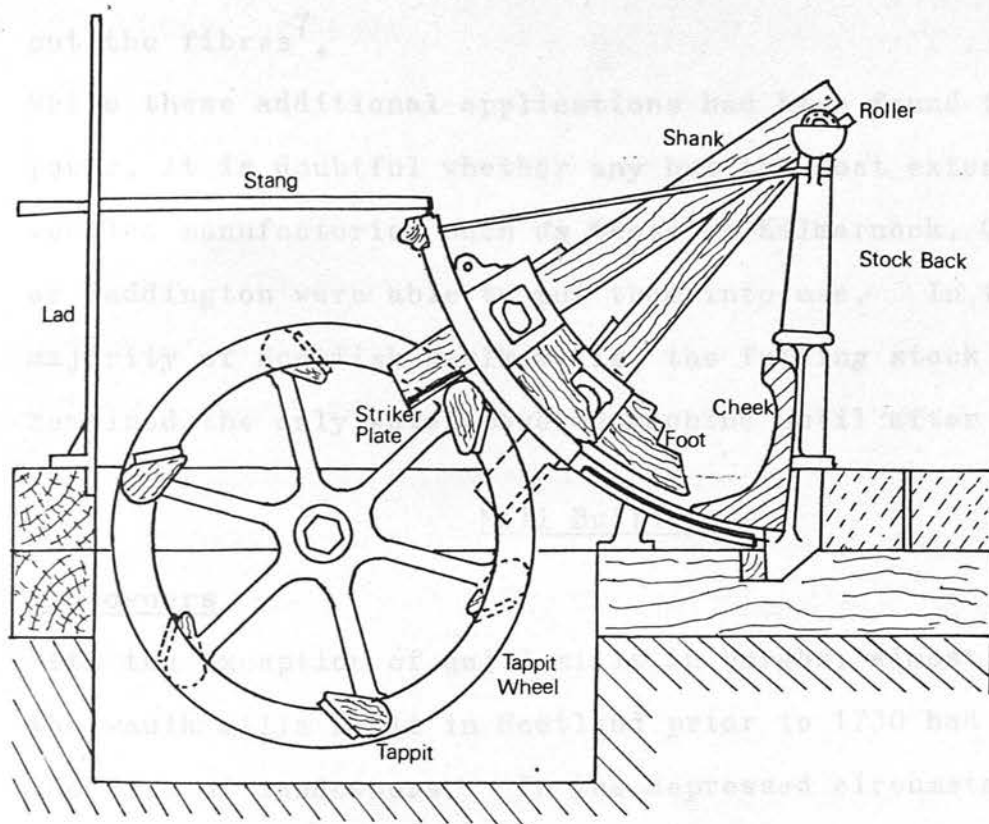
A company of Glasgow merchants, with a manufactory at Cam-lachie, petitioned the Board of Trustees in 1745 for help in building an English-style waulk mill, claiming that a "perfect fulling mill" was "a thing utterly unknown in this country"¹. Eventually, in 1754, a mill was built at a cost of £380², but in the meantime a second mill, at Hadding-

18
ton, had been constructed by Andrew Meikle, using information gathered on a tour of England financed by the Board of Trustees³. From the little technical information available from the time it would seem that one of the major advantages of English waulk mills was the use of multiple fulling stocks: the mill at Haddington had two and the Camlachie company, in its petition, alludes to the use of several in any one mill. By inference the Scottish mills of the time had only one fulling stock. It is also tempting to see the introduction of English designs as a change from more primitive falling-stocks with the feet or hammers dropping vertically and hanging-stocks with the feet pivoted at their ends (figure 18.1) but there is no concrete evidence to confirm this theory⁴. Whatever was the case, various improvements were incorporated into the Camlachie and Haddington mills, and possibly into another waulk mill which Andrew Meikle built for the ill-fated Garvaldfoot manufactory, Peebles-shire, in 1752-3⁵.

No further refinements seem to have taken place in 1783 when George Mercer, a small scale manufacturer at Wilderhaugh, Galashiels, claimed to be building a waulk mill on "a new and improved plan"⁶.

In addition to these minor modifications to fulling mills, the period 1730 - 1785 saw the introduction or rather the re-introduction, of other finishing machinery. In Chapter three reference was made to a gig mill and a frizzing mill, installed at New Mills and Restalrig respectively (p. 62). It was also suggested that these machines may have gone out of use after the early 1700's; whether or not this was the case, a gig mill was certainly in use at Haddington

18.1



during the 1750/s and a frizzing mill had been installed by the 1770/s. The Haddington mill also incorporated what was probably Scotland's first water-powered "teazer", a machine which removed foreign bodies from the wool and opened out the fibres⁷.

While these additional applications had been found for water-power, it is doubtful whether any but the most extensive woollen manufactories such as those at Kilmarnock, Camlachie or Haddington were able to put them into use. In the vast majority of Scottish waulk mills, the fulling stock itself remained the only water-powered machine until after 1785.

Mill Builders

Landowners

With the exception of guild mills in burghs, almost all the waulk mills built in Scotland prior to 1730 had been the work of landowners. In the depressed circumstances in which the woollen industry found itself after the Union and with enough existing mills to handle the coarse cloth still produced, it is unlikely that many waulk mills were built by landowners prior to mid-century. From about 1750 however, a new wave of mill-building started, in which landowners played a significant part.

While most of the earlier rural mills had been intended to serve the needs of individuals or custom weavers, the new waulk mills were often conceived as part of a larger venture, foreshadowing the development of integrated woollen mills after 1785 and reflecting a more general "Improving" movement among landowners.

The Haddington Tarred Wool Company of 1750 included several

landowners such as Lord Milton and Lord Deskford; a second company, occupying the same site, was dominated by landowning interests. The history of the Tarred Wool Company is considered at length later in this chapter. In this case the involvement of landowners was indirect: the mill was capitalised collectively by landowners and other parties.

None of them provided the site, nor could any of them expect to derive particular benefits for his estate through its presence. In short, it was more a business enterprise than a personal project.

A similar type of manufactory was established at Hawick about mid-century by three landowners, who took into partnership a Dunfermline weaver⁸. Although the original product was to be carpets, by the 1780's the finest wool was being set aside for making blankets, which found a ready market, and inkle-work had been started. Wight, visiting Hawick in 1782, found the partners starting work on "a fulling mill upon a most complete plan, adjacent to a fall of water"⁹.

Besides these "business enterprises" other manufactories of a similar type were developed as individual projects. James Dickson, the owner of Ednam estate, Roxburghshire, envisaged a canal from Berwick to Ednam and his estate as a great centre of industry. To that end, in 1765 he established a woollen cloth manufactory, fitted with the best machinery and manned by skilled workers from Yorkshire.

The principal products were English blankets. Besides the manufactory he built "a neat village" of brick houses with pantile or slate roofs. Only £200 was subscribed towards the Berwick canal, but the manufactory enjoyed a

modicum of success, though hardly on the scale originally envisaged¹⁰.

The 5th Duke of Argyll, who started a woollen manufactory near Inverary in 1774, was very similar to Dickson in his motivation, but worked in a much less favourable environment. Auspicious beginnings persuaded other Argyll landowners to subscribe, and by 1775 £700 had been raised. In November of that year attempts were made to find a manager; William Inglis, a manufacturer from Lanark, took the post on a nine-year contract with a salary of £100 per annum. From a minimum supply of four hundred stones of wool Inglis had to produce carpets, coarse cloth, Kendal "cottons" or stockings. Over £500 was laid out in 1777 and 1778 on building a factory house and several other buildings, including a waulk mill. Although Inglis proved to be a poor manager, the manufactory struggled on, largely through the efforts of the Duke of Argyll. The local population rose, and a school was built for workers' children, but in 1785 Inglis failed and handed over the factory and machinery, now in a very run-down state, to two Glasgow manufacturers. The woollen manufactory stumbled on through a succession of crises and managers until the early 1800's when, despite the repeated intervention of the Duke, it finally closed down¹¹.

A smaller, less ambitious project, the building of a waulk-mill, was undertaken by a few other Highland landowners; Grant of Grant at Craggan, Inverness-shire in 1750¹², Campbell of Barcaldine at Lismore, Argyll in 1713 and the Forfeited Estates Commission at the Kirkton of Strowan, Perthshire, in 1765¹⁴.

Merchants and Manufacturers

Two groups of merchants and manufacturers, definable, but not always distinct, were involved in the development of wool textile mills during the period 1730 - 1785.

On the one hand there were a number of fairly substantial merchants who became members of partnerships involved in wool manufacture, although this was not their prime area of interest. On the other hand there were small-scale waulker manufacturers who combined the operation of a waulk mill with other stages in wool manufacture, wool trading or even farming.

Members of the first group were active in the central Lowlands, notably in the west. In 1746 six or eight of the "most opulent and respectable merchants and inhabitants" of Kilmarnock established a woollen manufactory in the town to make carpets¹⁵. By 1754 a waulk mill had been added, at a cost of £100¹⁶. At Camlachie, near Glasgow, a group of Glasgow merchants established a woollen manufactory in, or shortly after, 1745. Finding that the woollen industry was "quite unknown in all its steps" in the Glasgow area, they petitioned the Board of Trustees for assistance in acquiring machinery and skilled workmen from England¹⁷. By 1754 they had built a waulk mill at a cost of £380¹⁸. In the east of Scotland William Caddell, a Cockenzie-based merchant, became one of the shareholders in the second Haddington Tarred Wool Company¹⁹.

The second group, while numerically greater than the first, were usually of far lesser stature financially. Indeed, they owe their status as merchants or manufacturers largely to the loose connotation of the terms in a Scottish context;

anywhere else they might not have qualified for the title. Some of them combined this work with other activities. In the light of subsequent developments it is significant that most of them were to be found in the Borders; most of the evidence comes from Loch's Tour. At Yetholm, Roxburghshire, Andrew Kerr, a tenant farmer, was also described as "manufacturer and clothier". According to Loch, he "does a great deal of business in the dressing and dying (sic) way, as well on his own account as for all the country around; he is capital in all branches of his business; he has good education, and endowed with a more than ordinary share of knowledge and good sense. He has a waulk mill and houses of his own property sufficient to carry on his work to a large extent"²⁰. At Melrose, John Lyell, "merchant, manufacturer and clothier" manufactured cloth with wool purchased from the Duke of Buccleuch's tenants, and had "a good waulk mill" of his own construction²¹. Alexander Hopkirk, "a noted clothier" had a waulk mill at Dryburgh, Berwickshire²²; William Darling at Cumledge Easter Waulkmill, was described as "dyer and woollen manufacturer", and George Mercer of Wilderhaugh, Roxburghshire, as "clothier and dyer" in 1783²³. Elsewhere in the Borders, at Galashiels, where there had been three waulk mills since the 16th century, and at Peebles, small "waulker-manufacturers" collectively rented waulk-mills or held them in feu²⁴.

Tenants and Artisans

Between 1730 and 1785 there are very few cases of tenants or artisans building waulk mills. In 1739 the tenant of

North Berwick mills had a waulk mill built at a cost of £47 19s 7d using capital advanced by and repayable to his landowner²⁵. The only other example which has been found was at St Andrews, where Robert Russell, feuer of Seamills and sub-tacksman of the town's flour mills, successfully petitioned the council to allow him to build a waulk mill and washing mill immediately below the flour mill²⁶. In addition to these two, the small waulker-manufacturers of the Border counties, who were certainly active during the third quarter of the 18th century, might equally well be included in this category as in the previous one, but they were differentiated from the run-of-the-mill waulker by their broader involvement in woollen manufacture and by the subsequent developments which stemmed from their early initiatives. Already, by 1730, there was an adequate stock of waulk mills in Scotland; immediately thereafter the woollen industry survived, but hardly flourished, and in the twenty years up to 1750 only one waulk mill is known to have been built. When, after 1750, building finally re-commenced, most mills were associated with ventures larger than artisans were able to finance. Admittedly, a Dunfermline weaver was a member of the partnership which established the carpet manufactory at Hawick, but his contribution was more probably one of skills than capital. Only after 1785 did tenants and artisans begin to play an active role.

The Board of Trustees

From its instigation in 1727, the Board of Trustees had a mandate to support the development of three sectors of the Scottish economy, namely fisheries, the linen industry and the woollen industry. The budget allocated to the woollen industry was from the first a small one and at least until 1785 it was very much a second priority to linen in the aid afforded to it by the Board.

At an early stage the Board of Trustees introduced a scheme under which persons could contract to sort and manufacture a certain quantity of wool²⁷. However, with inferior live-stock and poor marketing there was little prospect of the Board's reviving the industry²⁸.

As for a commitment to mill building, this did not come until about 1750 and then possibly through devious means. In 1750 the Haddington Tarred Wool Company persuaded the Board to finance a visit to England by Andrew Meikle who had already undertaken work for it in connection with the linen industry²⁹. Meikle was to inspect the best English waulk mills and bring back models. In the event, the Board not only paid for the visit and the models, but also gave the company a contribution towards the cost of constructing its mill, to an extent equivalent in value to an unfulfilled quota of woollen cloth previously contracted for by the company³⁰.

It may have been more than coincidence that this, the first waulk mill to receive financial aid from the Board, included among its shareholders two of the Board's foremost members, Lord Milton and Lord Deskford³¹.

The case of the Tarred Wool Company seemed to set a precedent

for the Board's providing financial and technical aid.

In 1753 they granted £100 towards the £254 laid out on a mill by Andrew Brown for William Douglas & Co., at Garvald-foot, Peebles-shire. Two years later however, the company was struck off the Board's list for failing to provide any of the woollen cloth contracted for³². In 1754 a grant of £40 was given towards a £100 mill at Kilmarnock and in 1755 a like sum was provided towards a £380 mill at Camlachie, Glasgow, but only on condition that it dressed coarse tarred wool at reasonable rates³³. Andrew Meikle, who had undertaken research and construction work for the Haddington company, attested to the completion of the Kilmarnock mill and appears to have acted in an advisory capacity at Garvald-foot, even though his "throng of business" delayed the mill's completion³⁴.

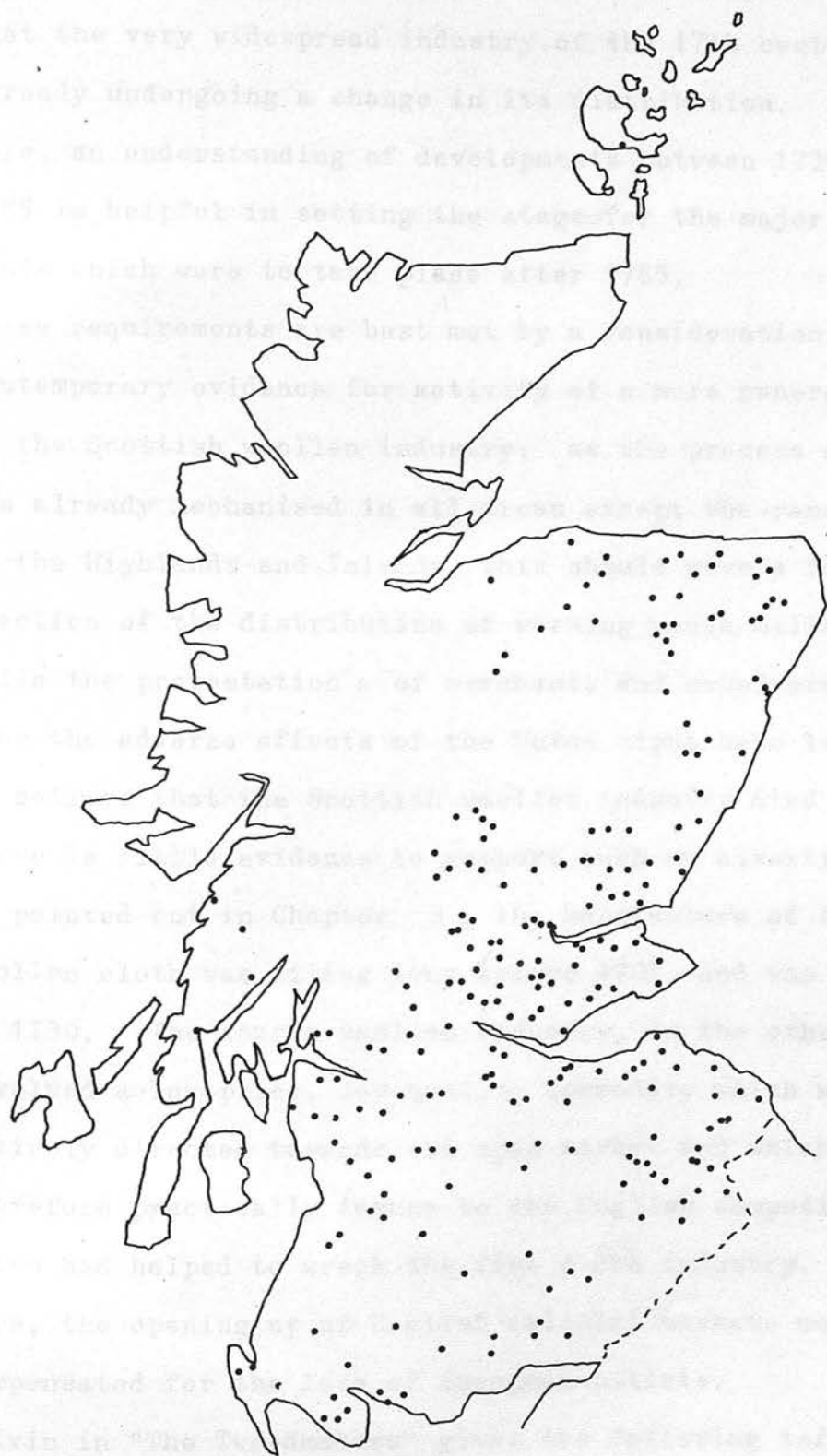
From the 1750's no further assistance was given to waulk mill building until the 1780's and then only grudgingly³⁵. During the intervening twenty years the Board's attention and finances had been fixed on the linen industry. However, one cannot place all the blame for lack of interest on the Board, for its attitude was merely a reflection of that of Scotland as a whole. Without improvements in livestock husbandry and technology, and with few mills being built anyway, there was little justification or scope for it to provide aid. The emphasis placed on linen was probably well-founded, for while pamphleteers occasionally bemoaned the lost status of the woollen industry, the potential markets, the scope for improvements in production and the overall public interest were probably greater in linen than in wool at that time.

Distribution and Chronology

An attempt to assess the distribution and chronology of waulk mills between 1730 and 1785 is fraught with difficulties, most of which stem from an "information vacuum" between the early and late 18th century.

In Chapter three it was established that at one time or another between 1550 and 1730 something like three hundred waulk mills operated in Scotland. Just how many of these were still active in 1730? We do not know; major sources such as the Register of the Great Seal and Poll Tax Returns stop short of 1730, while others such as the Old and New Statistical Accounts come too late. Of the few strictly contemporary sources, General Roy's map is only accessible as a poor redraughting which shows no more than forty sites, while the Scottish Record Office's GD series of estate papers mentions only fifty or so, including several identified by Roy. Some of these may have been mere place names, perpetuating the memory of mills already defunct. Just to complicate matters further, many of the mills mentioned by these and other sources were not necessarily built after 1730: they may well have been established much earlier, but were simply not previously recorded.

Without a considerable amount of additional research it is not possible to build up a reasonably comprehensive distribution map. Instead it will have to suffice to show those mills already recorded before 1730 and still operating, those first identified between 1730 and 1785 and those definitely established within that period (figure 18.2). This information will, in turn, be added to the distribution map for the much better documented period from 1785 to 1830.



This paucity of information does not, however negate the need to know the distribution of the industry during the period under consideration, for there is reason to believe that the very widespread industry of the 17th century was already undergoing a change in its distribution. Furthermore, an understanding of developments between 1730 and 1785 is helpful in setting the stage for the major developments which were to take place after 1785. These requirements are best met by a consideration of the contemporary evidence for activity of a more general nature in the Scottish woollen industry; as the process of fulling was already mechanised in all areas except the remoter parts of the Highlands and Islands, this should give a fair reflection of the distribution of working waulk mills. While the protestations of merchants and manufacturers over the adverse effects of the Union might have led one to believe that the Scottish woollen industry died in 1707, there is little evidence to support such an assertion. As pointed out in Chapter 3, the manufacture of fine woollen cloth was ailing long before 1707, and was extinct by 1730. The coarse woollen industry, on the other hand, involved a low-price, low quality commodity which was not entirely directed towards the open market and which was therefore practically immune to the English competition which had helped to wreck the fine cloth industry. Furthermore, the opening up of English colonial markets more than compensated for the loss of European outlets. Gulvin in "The Tweedmakers" gives the following information on the industry's distribution:

"In 1733 Patrick Lindsey admitted that Kilmarnock,

Stirling, Aberdeen and Edinburgh were not unimportant centres of woollen manufacture and that Musselburgh and Galashiels were also manufacturing for the open market. By the 1760's Postlethwayt found "many hundreds" of looms at work in the Stirling area and a number around Alloa. By then woollens were also expanding at Edinburgh and in the Lothians. At Aberdeen woollens were declining relative to linens, but the old cloths were still made "to a great amount" and the stocking trade was thriving"³⁶.

In addition to the coarse traditional cloth, the manufacture of light worsted fabrics was appearing among urban clothiers, partly in response to the needs of colonial markets³⁷.

In which areas then did the manufacture of woollen cloth decline and in which did it expand? In the Borders the pattern seems to have been one of redistribution. Pococke, travelling through Jedburgh in 1760, found that the town's former woollen manufacture had "quite decayed"³⁸, but at Hawick a carpet manufactory had been established about mid-century³⁹ and had also taken to making blankets by the early 1780's⁴⁰. At Selkirk, a woollen manufactory which later became the site of a major spinning mill was established in 1767⁴¹. Loch's tour during the late 1770's depicts a thriving woollen industry in several of the Border towns and villages, notably at Galashiels where 2,200 stones of wool per annum were being used to make blankets and Galashiels greys⁴². In 1780 Lord Gardenstone "found in this village a number of very industrious people"⁴³.

In the west of Scotland, notably in Ayrshire, the woollen industry continued to operate and in Kilmarnock and Maybole

manufactories were established⁴⁴.

In the Lothians wool lost a little ground to linen and even the manufacture of broadcloth and blankets at Haddington had a very chequered history (pp. 392-396).

In Fife and Angus one would have expected the linen industry to have affected the fortunes of the woollen industry to a greater extent; in both counties there had been large numbers of waulk mills prior to 1730 and some may have been converted to dress flax or to serve other purposes. On the other hand Dalkeith and Haddington were still sending wool north to Fife in the late 1770/s and a broad cloth manufactory, proposed for Dundee in the 1770/s, offers further evidence that the woollen industry was more resilient than might have been supposed⁴⁵.

In the north-east where competition from linen was less marked, wool was still being imported from southern Scotland in the 1770/s⁴⁶. In the Highlands there is evidence of the extension of the woollen industry with the establishment of the Inveraray manufactory and the building of waulk mills at Lismore in Argyll, Craggan in Inverness-shire, Strowan in Perthshire and Ullapool in Ross-shire⁴⁷.

Broadly speaking, the distribution of woollen manufacture in Scotland was, with the exception of developments in the Highlands, little different from that of the 17th century, even though the products were more diverse; most of the changes in distribution were to take place in the years between 1785 and 1830, although the vitality of waulker-manufacturers in the Borders was already apparent, as was the beginnings of regional specialisation, such as the Ayrshire carpet manufacture.

All in all, the woollen industry and by implication waulk mills, if not flourishing to the same extent as linen, was still functioning in most areas during the period 1730-1785, a fact which goes some way towards explaining its forceful revival in the period 1785 - 1830.

A Scottish Woollen Mill

The Tarred Wool Company's Mill, Haddington

Before concluding this chapter it is worth examining in more detail one of the mills which, in many ways, characterised developments in the use of water-power in the woollen industry between 1730 and 1785. The most interesting, and certainly the best documented, is the Tarred Wool Company's mill at Haddington.

The closure in 1713 of the New Mills manufactory near Haddington may have brought an end to the Scottish fine woollen industry, but not to the woollen industry as a whole in the Haddington area. The town continued to function as a market for coarse wool, produced in the uplands to the south and the manufacture of coarse cloth still took place in the town. In the 1730's part of this manufacture was located in the Nungate, a suburb of Haddington, and the town's waulk mill, which pre-dated New Mills, continued to operate⁴⁸.

In 1750 a new venture was started in the town. Unlike New Mills it produced coarse cloth and on account of the then current practice of tarring wool to protect sheep from infection, it went under the title of the Tarred Wool Company.

Prior to its establishment, three Haddington clothiers,

Alexander Maxwell, Henry Hepburn and William Lawson had contracted with the Board of Trustees to produce two thousand stones of woollen cloth at 1s per stone⁴⁹. In 1750 they were joined by other parties, notably Lord Milton and Lord Deskford, and a company was formed to last for two nineteen year periods with a stock of £6,000 divided into one hundred and twenty shares. The first advance of capital was to one-fifth⁵⁰. Although the company was successfully established, it found itself "at a great loss for want of a waulk mill"⁵¹. In June 1750 Alexander Maxwell, one of the founder members, petitioned the Board of Trustees, "proposing to send Andrew or Robert Meikles (sic) to England to procure models of the best waulkmills used there for enabling them to erect a proper one, if the Board would defray the expense of the journey and of the model"⁵². To this the Board agreed. Having visited England and returned with models of the best waulk mills there,⁵³ Andrew Meikle was employed to survey the River Tyne and Colstoun Water and report on a suitable site. In Meikle's opinion the best location was on the Tyne, a little to the west of Haddington's east mill; the mill "would be sufficient and constantly a going mill with that fall, except in the event of an extraordinary drought, and a high speat in the water"⁵⁴. The Tarred Wool Company petitioned the Burgh Council, asking for a feu of a site of eighty square feet and for financial aid, "as the burgh must reap great benefit and advantage by the said manufactory being carried on within this town". Although the site had already been promised to James Spalding for a lint mill, Lord Milton was able to use his influence

as a member of the Board of Trustees, and in the event the Council unanimously agreed to accommodate "so beneficial a trade as the manufactory of tarred wool" offering the Company a feu at £2 Scots per annum, provided that safeguards were laid down for the town's malt mill and waulk mill. On this basis the Tarred Wool Company built a two-stock mill, a freese mill and a teaser, all driven by water-power⁵⁵. The total cost of Meikle's visit to England, the construction of models and of the waulk mill came to £390 18s 3d. According to the testimonies of three clothiers, the mill "answered extremely well". £100 was made available from the Board's model fund⁵⁶.

While little information is available on the Company's fortunes, it does not seem to have prospered. In 1754 the two thousand eight hundred stones which the Company had contracted for had to be reduced to two thousand four hundred⁵⁷ and by 1758 the first company had collapsed and given way to a new one⁵⁸.

The new partnership comprised landowners such as Lord Milton and Lord Solstoun, a merchant, William Caddel and a local minister. Management was in the hands of George Sawyers and Henry Hepburn, clothiers in Haddington⁵⁹. By August 1759 all the shareholders' capital had been called in, including over £500 needed to buy the waulk mill and other effects from the old company⁶⁰.

At one stage a water-powered "willow" was installed, to prepare wool for carding but this was later removed and the process performed by hand. The friese mill was extensively used, not only by the Company itself, but also by other manufacturers from as far away as Dunglass, 16 miles

to the east⁶¹. The power to drive these machines was made available by the removal of the second stock shortly after 1750. During droughts the town's malt mill ran by day and the waulk mill by night⁶².

The new company lasted longer than its predecessor, making broadcloths and blankets. A sample of its cloth, a heavy, well-felted brown material, is contained in the Saltoun Papers at the National Library of Scotland⁶³.

According to various sources⁶⁴, the Tarred Wool Company continued to produce woollen cloth until 1775 or 1789.

The earlier date seems the more likely, for in that year the manufactory building was advertised for sale or let.

The description contained in the advertisement gives a detailed picture of the equipment at the mill:

"in the first floor, a dye house with three large boilers, dyestuff-cellar, and drying stove, a fulling mill with two fulling stocks, press shop with two presses, a shear shop containing two pairs of shear-boards, &c. In the second floor, a weaving shop, burling shop, reeling and warping room, freizing mill, scribbling room with a good ware room and lodging room for the manager. In the upper floor, a drying house forty feet by twenty, and wool lofts eighty feet by twenty feet⁶⁵.

The confusion over the date of the Company's disbandment may stem from the fact that one of its members, George Sawyers, took over its running in 1775 and continued to make high quality blankets until 1789⁶⁶.

When Loch visited the town in the late 1770's he found the woollen industry in a healthy condition. Of the six

thousand stones of wool brought into Haddington during 1776 five thousand stone was manufactured locally, the remainder going to Fife. The principal products of the town were broadcloths, sold at 4s to 10s 6d per yard, narrow cloths at 1s 6d to 6s and English-style blankets at 4s to 18s each. The goods manufactured there, mostly for the Edinburgh and Glasgow markets, were valued at £5,000 Sterling per annum, compared with £2,800 for the raw wool, including that exported to Fife. The town also had a flourishing dyestuffs industry, notably in woad, four tons of which were produced per annum⁶⁷.

After Sawyers' departure the mill was sold to William Wilkie who brought skilled workers from Yorkshire and attempted unsuccessfully to continue the woollen manufacture⁶⁸. In 1795 he leased the premises to Hay Smith for a thirty-eight year period; Smith installed additional machinery to grind mustard and dyestuffs, including indigo⁶⁹. In 1803 he became bankrupt and the mill was leased to James Dawson, who used it as a woollen manufactory with two fulling stocks and carding, raising and scribbling machines⁷⁰. The manufactory seems to have closed down for good in 1814, following a legal case over water rights. The town's own waulk mill continued to operate until mid-century when, for want of business, it too closed down⁷¹.

In following the history of the Tarred Wool Company's mill we have moved well beyond the period 1730 - 1785, to which we will return in the next chapter.

- 1 : NLS Acc.2933/328/ f.1
- 2 : SRO NG1/1/12 13/12/54
- 3 : SRO NG1/1/11 7/7/51
- 4 : For other examples of vertical stamps see chapters on paper, bleachfields, lead mining and minor users of water power.
- 5 : SRO NG1/1/12 15/12/52; 16/11/53
- 6 : SRO NG1/1/23 22/1/83; 2/7/83
- 7 : OSP 485:25 Haddington Town Council v. Haddington Tarred Wool Company
- 8 : Wilson, R. "A Sketch of the History of Hawick"
Hawick 1825 252
- 9 : Wight, A. "The Present State of Husbandry in Scotland"
4 vols. Edinburgh 1778-84 IV 606
- 10 : OSA XI 303 Ednam, Roxburghshire
Burleigh, J. "Ednam and its Indwellers" Glasgow
& Dalbeattie, 1912 198
- 11 : Lindsay, I.G. & Cosh, M. "Inveraray and the Dukes of Argyll" Edinburgh 1973 273-5
- 12 : SRO GD248/125/47
- 13 : SRO GD170/416 (1759)
- 14 : Miller, A.H. (Ed.) "A Selection of Scottish Forfeited Estates Papers, 1715; 1745" SHS LVII (1909) 209
- 15 : Aiton, W. "General View of the Agriculture of the County of Ayr" Glasgow, 1811 59
- 16 : SRO NG1/1/12 13/12/54
- 17 : NLS Acc 2933/328
- 18 : SRO NG1/1/12 13/12/54
SRO NG1/1/13 19/12/55

- 19 : Loch, D. "A Tour through Most of the Trading Towns
and Villages of Scotland" Edinburgh 1778 48
- 20 : Ibid., 47
- 21 : Ibid., 45
- 22 : Ibid., 46
- 23 : SRO NG1/1/23 22/1/83
SRO NG1/1/24 10/12/83
- 24 : Loch, op.cit., 44-5, 51
- 25 : SRO GD110/764
- 26 : Kettelbey, C.D.M. "Tullis Russell. 1809-1959"
Markinch, 1967 12
- 27 : SRO NG1/1/1 8/12/1727
- 28 : Gulvin, C. "The Tweedmakers" Newton Abbot, 1973 31
- 29 : SRO NG1/1/10 8/6/50
- 30 : SRO NG1/1/11 7/6/51
- 31 : NLS Acc.2933/354 6/4/1758
- 32 : SRO NG1/1/12 16/11/53
SRO NG1/1/13 19/12/55
- 33 : SRO NG1/1/12 13/12/54
SRO NG1/1/13 19/12/55
- 34 : SRO NG1/1/12 15/12/52
- 35 : SRO NG1/1/23 22/1, 2/7, 6/8/83
- 36 : Gulvin, op.cit., 32
- 37 : Ibid., 32
- 38 : Pococke, R. "Tours in Scotland, 1747, 1750, 1760"
SHS I (1887) 344
- 39 : Wilson, op.cit., 252
- 40 : Wight, op.cit., IV 606-7
- 41 : Craig-Brown, T. "The History of Selkirkshire" 2 vols
Edinburgh 1886 II 176

- 42 : Loch, op.cit., 44-51
- 43 : SRO NG1/1/22 9/8/80
- 44 : SRO NG1/1/12 13/12/54
- 45 : Loch, op.cit., 5, 9
- 46 : SRO NG1/1/21 5/3, 30/7/77
- 46 : Loch, op.cit., 5, 9
- 47 : Inveraray: Lindsay & Cosh, op.cit., 274 (1777-8)
Lismore: SRO GD170/416 (1759)
Craggan: SRO GD248/125/47 (1750)
Strowan: Miller, op.cit., 209 (c.1765)
Ullapool: Ibid., 97 (c.1760)
- 48 : Gray, W.F. & Jamieson, J.H. "A Short History of Haddington" Edinburgh, 1944 114
- 49 : SRO NG1/1/10 20/12/49
- 50 : NLS Acc 2933/354 Contract of Co-partnery, 1750
- 51 : SRO NG1/1/10 8/6/50
- 52 : Ibid.,
- 53 : SRO NG1/1/11 22/5/51
- 54 : OSP 485:25
- 55 : Ibid.
- 56 : SRO NG1/1/11 3/1/52
- 57 : SRO NG1/1/12 13/12/54
- 58 : NLS Acc 2933/354 General Meeting of the Proprietors
of the New Company for Tarred Wool at Haddington 6 Apl 1758
- 59 : Ibid.
- 60 : NLS Acc 2933/354 George Sawers to Lord Milton, 20 Jul 1759
- 61 : OSP 485:25
- 62 : Ibid.
- 63 : NLS Acc 2933/354
- 64 : Gray & Jamieson, op.cit., 116

- 64 : OSP 485:25
- 65 : Caledonian Mercury April 19th 1775
- 66 : Gray & Jamieson, op.cit., 116
- 67 : Loch, op.cit., 9
- 68 : Martin, T.C. "Old Haddington" TELA&FNS XII (1970) 57-8
- 69 : OSP 485:25
- 70 : Ibid.
- 71 : Martin, op.cit., 58

WOOLLEN MILLS 1785 - 1830Technology

With the exception of fulling and the few innovations which had been introduced to a handful of mills during the previous hundred years, the Scottish woollen industry of 1785 was still unmechanised. By 1830, however, so many new inventions had been applied that every one of the numerous manufacturing processes could be performed by water-powered machinery. In describing this process of innovation, it is impossible to follow a logical chronological sequence without losing track of the sequence of operations by which wool was manufactured. For this reason, it has been decided to consider each process in order of manufacture.

Teazing

Wool, having been sorted and washed had to be disentangled prior to slubbing and carding. This process, known as teasing, was one of the first to be mechanised after 1785, using a machine known as a teaser or willy. One was installed at the Tarred Wool Company's Haddington mill at an unknown date¹, possibly before 1785 and a hand-driven "willow" was subsequently purchased by Galashiels manufacturers². The first water-powered teaser to which a date can be assigned was one proposed by George Mercer at Wilderhaugh Burn Mill, Galashiels: in 1787 he offered to pass on information concerning a water-powered teasing machine of his own design, in exchange for help from the Board of Trustees in constructing it. Although the Board asked Mercer for an estimate, they later decided that the machine was unsuited to the purpose and presumably gave no help towards its development³. In

1790 Andrew Pringle, millwright at Brunstane Mill, Midlothian, claimed to have perfected a water-powered teaser. The machine was referred to Galashiels manufacturers and their favourable response persuaded the Board of Trustees to award him £30⁴.

At about the same time Alexander Brodie, a native of Peeblesshire who had made his fortune in London incorporated teasing machinery in a mill at Innerleithen⁵.

In 1791 there was a second petition from Mercer, in which he too claimed to have perfected a water-powered teasing machine; on this occasion a grant was provided towards this and other water-powered machinery⁶. Whether the successful design was the work of Pringle, Mercer, a combination of both or simply a plagiarism from elsewhere, by 1800 teasing machines had been installed elsewhere in Galashiels, in Berwickshire, Kirkcudbrightshire, the Hillfoots and as far north as Ross-shire⁷. It may also have been applied in an early woollen mill at Duntocher, Dunbartonshire⁸. By 1810 it had been brought into use in most of the Scottish counties and continued to spread thereafter, as mills were established or refitted.

Scribbling and Carding

Having been teased and oiled, the wool underwent two carding processes, scribbling and carding proper. Traditionally carding had been a slow and laborious manual process using wooden cards with metal teeth. Cylindrical cards, turned by a crank, were introduced to England in 1748 and in 1775 Sir Richard Arkwright patented a carding machine for cotton⁹. The first wool carding machines were set up in Yorkshire in the early 1770's, using machinery patented by Bourn¹⁰, and by the late 1780's Arkwright machinery was available, the

patent having been overturned¹¹.

In 1784 George Mercer had visited the North of England and in the following year he succeeded in obtaining a £30 Board of Trustees grant towards a dyehouse, a large woad vat and scribbling machines, similar to those which he had seen at Kendal and Leeds¹². In the same year three other Galashiels manufacturers who had probably seen Mercer's scribbler, successfully petitioned the Board for aid towards installing such machines¹³.

Although there was a further application from Galashiels in 1788¹⁴, it would appear that these early scribblers were driven by hand, for in 1791 George Mercer again petitioned the Board, this time for aid to bring a water-powered scribbler from England, to assemble it and to provide someone to train his son and himself in its operation. All this would suggest that a water-powered version of the machine was hitherto unknown in Scotland¹⁵.

At about the same time, scribblers were independently introduced elsewhere in Scotland. In 1791 John Archibald and another manufacturer in Tullibody asked for assistance in procuring scribbling and carding machines, but the money offered was not taken up until the late 1790's when members of the Archibald family established a mill at Menstrie, Stirlingshire¹⁶. During the 1790's scribbling machinery was installed at mills in Selkirkshire, Roxburghshire, Berwickshire, Ayrshire, Stirlingshire, Nairn and Ross-shire¹⁷. During the early 19th century it came into general use in Scotland.

Carding machines, which performed the second carding process followed close on the introduction of scribbling machines.

Charles Baird, one of the partners in Stoneywood Mill, Aberdeenshire, brought two carding machines from Rochdale in 1790 and these were assembled by a Mr. Matthew Young. Soon afterwards the same Matthew Young fitted up machinery for Messrs Kilgour at Kinmundy, Aberdeenshire, and in 1797 he and Robert Ogston established a woollen mill at Strichen¹⁸. Brodie's mill at Innerleithen also incorporated water-powered carding machinery¹⁹. George Mercer soon added a carding machine to his mill and in 1792 William Thomson, "engineer and millwright", having recently returned from Yorkshire and Lancashire, informed the Board that he could make and install a full set of carding and spinning machinery for wool at £170 to £180²⁰. Carding machinery was introduced to several counties during the 1790's and became general between 1800 and 1830.

Double carding engines are first mentioned at Dalmellington, Ayrshire, in 1796²¹ and another such machine, apparently introduced from Lancashire was being used at Jedburgh in 1807²². Many others were installed during the early 19th century, but the significance of "double" is not clear²³. In 1813 James Darling at Cumledge, Berwickshire, claimed to have substituted a roller, covered with filleting cards, for the crank used formerly for taking wool off the last roller (doffer) of the machine. Three machines incorporating these improvements were successfully applied at Jedburgh, but it is difficult to ascertain the authenticity of Darling's claims²⁴.

The doffer of the carding machine had spaces in the card clothing which covered its surface, in which the wool accumulated in webs about four inches wide. A final cylinder,

with fluted surface, gathered these webs into ropes of about half an inch in diameter²⁵. Until the 1830's these were joined together or "pieced" by hand, before being spun²⁶. Combing, a process in worsted manufacture equivalent to flax heckling, was mechanized by 1822 at Crookholm, Kilmarnock²⁷.

Slubbing and Spinning

Just as the carding process was divided into two parts, so also was spinning. The first stage, slubbing, gave the untwisted "ropes" from the carding machine a loose twist, using a machine known variously as a slubber, roving machine or billy. The billy, adapted from the cotton industry, was initially driven by hand, but water-powered machines had appeared in Scotland by the late 1790's²⁸. Slubbing billies came into general use in the early 19th century, but it seems unlikely that they were ever fully adapted to water-power.

The second part of the spinning process, the spinning itself, also used a machine borrowed from the cotton industry. The machine in question, the jenny, had been patented by James Hargreaves in 1770²⁹, and had been applied to the Edinburgh woollen industry by the late 1770's³⁰. The jenny was a hand-powered machined and remained so throughout the period, although a claim to have devised a water-powered jenny was made in 1816³¹. The water frame, by means of which water-power was applied to the cotton industry, was unsuited to the short fibres used by most of the Scottish woollen industry³², but the spinning mule was successfully applied by W. & D. Thomson at Rosebank Mill, Galashiels in 1814³³. In 1816, at about the same time as it was being applied at Leeds, Willi-

am and Simon Bathgate, millwrights in Galashiels, claimed to have devised a water-powered machine which could spin at half the cost of the jenny³⁴. The mule was only slowly introduced, and was still comparatively rare in 1830. Machines for twining and reeling yarn were installed at various mills during the early 19th century, but do not appear to have been water-powered³⁵.

Weaving

Little need be said about weaving in the present context for the power loom did not appear in the woollen industry until the mid 19th century. In 1830 wool was still being dyed after weaving rather than earlier in its manufacture, as came to be the case more recently. Picking machines, to remove foreign bodies from woven cloth, were in use by the mid 1820's, but were probably not water-powered.

Fulling

Little change seems to have taken place in the long established technology of cloth fulling or waulking. A fulling mill "on a new construction", the invention of George Pringle, millwright in Earlston, was erected at Dryburgh by the Earl of Buchan, c.1789³⁶, but although many new mills were constructed thereafter, no further improvements seem to have taken place.

Raising

After fulling, the surface of the cloth was raised by means of teazels, used individually or mounted collectively on frames. Raising or gig mills had appeared in Scotland in the 1690's and were in use at the Haddington Tarred Wool

Company's mill some time after 1750³⁷. Thereafter, they are not mentioned again until 1790, when one was proposed at Jedburgh³⁸. From Galashiels there were applications for aid towards raising machines in 1792 and 1794³⁹ but in a petition dated 1807 Richard Lees claimed to have just introduced it to the town⁴⁰. Gig mills or raising machines are referred to in several subsequent petitions from Galashiels where there seems to have been little if any of the resistance encountered in England⁴¹. Although they may have been introduced to other areas outside the Borders, there is nothing in the Minutes of the Board of Trustees to confirm such a view.

Shearing

Once the surface of the cloth had been raised, excessively long fibres were cropped or sheared. Traditionally large hand shearers were used, but a shearing machine on which several pairs of shears were driven by water power, was patented in France in 1784 and in England by J. Harmer of Sheffield, in 1787. Opposition by workers prevented their widespread use in England until after 1815⁴².

The first machine to be brought to Scotland was installed at Galashiels in 1811 by Richard Lees, using a new and powerful water wheel⁴³. According to Lees, a man or a boy could operate four to six pairs of shears at once, and machines of this type were introduced to Peebles in 1812, Selkirk in 1813 and Jedburgh in 1816⁴⁴. Lees later brought from England a "perpetual backer" which was to be used with a cropping machine⁴⁵.

A more sophisticated machine, the principle of which was

later applied to the lawnmower, stemmed from a design patented by an American, Samuel Dorr, in 1794. Later versions of this were patented by two Englishmen, Lewis and Collier, in 1815 and 1818 respectively⁴⁶. In 1820 James Patterson brought what he described as an American Cropper to Galashiels, describing it as cheaper and more efficient than the earlier type⁴⁷. Lewis-type cropping machines were also being used in the town by the late 1820's⁴⁸. Beyond the Borders, cropping machines of one type or another are known to have been introduced to Banffshire and Dumfriesshire before 1830 and were probably in use elsewhere⁴⁹.

From the preceding account of the mechanisation of the woollen industry, the dominant role of Galashiels manufacturers is clearly evident. While this may be partly due to better documentation through their frequent recourse to the Board of Trustees, it is also true to say that they set the pace for mechanical innovation in the Scottish woollen industry throughout the period. As will become apparent in subsequent sections, this was not the only respect in which Galashiels, or more broadly speaking, the Borders, led the industry.

Competition from Steam

More than any other sector of the textile industry wool manufacture kept its dependence on water power well into the 19th century. As many of the sites which it occupies were in close proximity to uplands with good water catchment qualities, water power was readily available in adequate quantities. Furthermore, these areas offered little competition from other users, so that as the number of mills and the range of water-powered processes increased, the industry was able

to take up almost all the water power available in its area. Some districts, notably the Borders, were far removed from coal supplies, at least until the coming of the railways. The earliest steam-powered mills were built in the Stirling-Hillfoots area. Stirling itself had a long-established woollen industry but very poor water resources in its immediate vicinity; the town's first steam-powered mill was founded c. 1811⁵⁰. In the Hillfoot towns and in Alloa, a water-powered industry was created on very limited supplies and before 1830 the expansion of the industry necessitated the application of steam power.

A similar set of circumstances applied in other major urban centres such as Kilmarnock, Ayr, Glasgow and Aberdeen, but in the Borders steam power was very late in arriving: the first steam mill in Galashiels was not started until after 1830 by which time all the available water power in the town had been taken up⁵¹. Of ten mills in the Hawick area in the late 1830's only one was powered by steam⁵². Outside the main manufacturing districts the more isolated mills continued to use water power alone long after 1830. The 1839 Factory Returns show that in the mills surveyed there were one hundred and sixteen water wheels against only thirty-seven steam engines, the former producing 1198 horse-power out of a total of 1822 horse power.

Mill Builders

Landowners

By the 1780's the contribution which landowners could make towards the development of the textile industries was relatively small. The process of mechanisation already outlined

with corresponding increases in the scale of individual units, meant that an integrated woollen mill required not only substantial capital but also a great deal of technical and commercial expertise. For this, merchant and waulker manufacturers were much better equipped, while in the case of smaller, more specialised mills, such as those engaged in waulking or carding, textile trade artisans and particularly waulkers or dyers, were becoming sufficiently well-established to undertake mill building on their own account. At the same time, the landowner still had a role to play in deciding whether a mill should or should not be built, and as title-holder to land, his reluctance or willingness to grant tacks or feus could decide the fate of a proposed mill. For a small landowner, the additional income and other benefits which favoured the estate development might lead him to look favourably on mill development, but the larger, more prosperous landowner could afford to be more discriminating and might consider the aesthetic loss to be greater than any potential economic benefit. Wilson, writing in the mid-1820's, contrasts the attitudes of landowners at Hawick and Galashiels: for some years, falls of water in the Hawick area could not be made use of "owing to a whim of the late Duke of Buccleuch". "His Grace seems to have forgotten that the manufacturers and their workers were the principal consumers of the produce of his land". At Galashiels however, where ninety-nine year leases were readily available, "Mr. Scott of Gala, and his father, whose views seem to have been equally sound and liberal, have raised a town which is likely to become the Leeds of Scotland"⁵⁴. Without detracting from their achievement, it should be added

that the Scotts of Gala were able to bring this about without themselves laying out any capital.

Financial and other incentives from landowners were sometimes a pre-condition for aid from the Board of Trustees⁵⁵; by providing this a landowner could promote the development of the woollen industry on his estate without any direct involvement. At Kingussie, on Speyside, a small woollen company was founded in 1805 and received a £100 grant from the Board of Trustees on condition that it obtained "encouragement" from the Duke of Gordon prior to making further claims⁵⁶.

A second petition in 1807 was turned down, but by 1808 the Duke of Gordon was affording the company "various conveniences" and in 1810 it was successfully petitioning the Board for a further £100⁵⁷.

Above and beyond this general role, there were cases in which the landowner played a more active part in the establishment of woollen mills. Broadly speaking, these cases involved either localities in which the mechanised industry had not yet been established, or were connected with the development of planned villages. Almost all took place in the 1790's or early 1800's.

The earliest example of an integrated mill built by a landowner was Caerlee Mill, Innerleithen (c.1790), one of the first mechanised mills in Scotland. Its founder, Alexander Brodie, was hardly typical of Scottish landowners: he had started his working life as a blacksmith in Traquair parish, Peeblesshire and made his fortune as an ironmaster in Shropshire, before returning as a landowner to his native county. The mill was built on four storeys, with water-powered carding and roving machinery on the lower floors, jennys on the top

floor and a separate waulk mill. The decision to build was based more on philanthropy than on sound economic judgement and its eventual success, under a Galashiels manufacturer, was only achieved after a number of tenants had failed to run it profitably⁵⁸.

On the Black Isle, David Urquhart of Braelangwell built a woollen mill in 1796, at a cost of £1,000, with a view to introducing industry to Cromarty-shire and thereby staving off emigration. Machinery to tease, scribble, card and spin wool started operating in January 1797 and a manager was brought from the south. Nothing is heard of the mill after 1799, but it still stands today⁵⁹.

In Galloway landowners played an active role in organising companies to operate woollen mills during the late 18th century⁶⁰. One such co-partnership, a leading member of which was Lord Daer, had a mill at Old Kirkchrist which had once been a distillery and which was to have been a cotton mill before a turn-down in trade persuaded the proprietors to install machinery for teasing, scribbling and carding wool instead⁶¹.

This first category, concerned with introducing the mechanised industry to new areas overlaps with the second which involved planned villages. At Grantown-on-Spey Grant of Grant established a woollen manufactory with eight looms and a carding machine⁶², whilst in Caithness Sir John Sinclair persuaded Alexander Walker, an Aberdeen manufacturer, to settle at Halkirk and carry on the manufacture of wool, on condition that Sir John provided £250 towards machinery⁶³. At the opposite end of the country, in Dumfriesshire, General Dirom of Mount Annan built a large woollen mill on a good fall of water adjacent to his new village of Brydekirk⁶⁴. James

Little, who took on the mill, promised in 1800 to pursue the woollen manufacture "on a scale much greater than has yet been attempted", but in making so brash a claim, lost the opportunity to obtain help from the Board of Trustees⁶⁵. Nevertheless, the mill enjoyed greater success than most of those established by landowners.

Initiatives of the type outlined above represented only a small proportion of the woollen mills built during the period 1785 - 1830. In choosing to build them, landowners seem to have been motivated by the potential economic and social benefits of having woollen mills on their own estates under their own control. In this respect, in their dedication to a particular project and in their blindness to economic realities they represented the remnants of the 18th century Improving movement, a movement out of touch with the harshly competitive economic climate of the early 19th century. Managers with a knowledge of the trade came and went, but it was not until control passed to experienced manufacturers that the surviving mills became competitive. Many estates, particularly those where improved breeds of sheep had been introduced, could and did support small carding mills, but as will become apparent later, the initiative to create these came from mill-tenants and textile trade workers rather than from a dying race of improving landowners.

Merchants and Manufacturers

As with linen, so also with wool, merchants and manufacturers made up the bulk of mill builders between 1785 and 1830.

The two-fold division used in the previous chapter also holds good for the period now under consideration, although

many of those who started out as small-scale clothiers or waulker-manufacturers had achieved the status of merchants or manufacturers by the 1830's.

A very fine dividing line lay between the waulkers and dyers, who might be categorised as tenants or artisans, and the small waulker-manufacturers of the late 18th century.

Several of those who described themselves as manufacturers were probably men of very limited financial means who saw the development of carding and other manufacturing processes as a means of diversifying their interests. Unfortunately it is not possible to gauge the level of control which they already had over manufacturing; in some cases it must have involved little more than buying cloth from weavers, fulling it and putting it through the first stage of marketing.

John McKay, who in 1789 described himself as "woollen cloth manufacturer" in Cluny parish, Aberdeenshire, did not even have a waulk mill and had to look to the Board of Trustees for help in building one⁶⁶. In 1794 John Young, "woollen manufacturer" at Cortachy, Angus, also had to enlist the help of the Board, this time in purchasing a scribbler costing no more than £40. Even with this help it appears that he had given up "manufacturing" by 1797⁶⁷.

Not all of the small manufacturers were quite so impecunious and some, from modest beginnings, managed to develop into large-scale manufacturers. Besides the waulker-manufacturers of Galashiels, one of the best examples is that of the Darling family at Cumledge, Berwickshire. William Darling was a dyer and woollen manufacturer at Cumledge Easter Waulk-mill when he decided to "extend the woollen manufacture" with the help of his sons. In 1797 he applied for a grant

towards water-powered scribbling, carding and slubbing machinery at an estimated cost of £127⁶⁸. A fifty per cent grant was provided, and although Darling seems to have underestimated the cost, his son James installed further machinery, successfully ran the woollen mill and made improvements in carding mill design. The mill continued to operate until the 1960's⁶⁹. It is at Galashiels, however, that the transition from waulker-manufacturer to capitalist-manufacturer is clearest. By 1790 there were already five waulk mills in Galashiels: Upper-, Mid- and Nether-Waulkmills, which had been in existence since at least the 1580's, Wilderhaugh, built in 1783 by George Mercer, "clothier and dyer", and Buckholmside, built by Pringle of Torwoodlee in 1788⁷⁰ (figure 19.1). The waulkers who tenanted these mills, individually or collectively, had already attained the status of manufacturer by taking in, fulling and marketing woven cloth. For various reasons they were able to assume a wider control over the industry in the late 18th and early 19th centuries. As has already been shown, they had a keen awareness of technical advances; since the machinery was relatively inexpensive, and since they already controlled water-powered sites, it was only a small step to install the new water-powered machinery, particularly where it was financed jointly. As much of the machinery was for yarn preparation, the employment of hand-then jenny-spinners was a natural step to take, and by supplying this yarn to weavers they could complete the cycle of control over the industry.

By 1805 all five waulk mills had been adapted or rebuilt to house preparing, carding and finishing machinery. At Wilderhaugh and Buckholmside mills water-powered preparing

19.1

□ BUCKHOLM 1846
BUCKHOLMSIDE WAULKMILL 1788, 1793

Gala Water

1783

WILDERHAUGH 1795

GALABANK 1818

G A I L A S H I E L S

LADHOPE 1793

ROSEBANK 1805

WEIRHAUGH 1797

WAULKMILLHEAD 1802

MID 1793

NETHER 1805

HUDDERSFIELD 1818

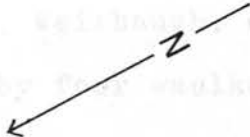
GALA 1826

ABBOTS 1841

SCALE km

1

0



and carding machinery was installed by the waulker-manufacturers who already tenanted them, in 1791 and 1793 respectively⁷¹. Mid-mill was rebuilt to a height of sixteen feet in 1793, Waulkmillhead (Upper-mill) to twenty feet in 1802 and Nether Mill to twenty-two feet in 1805; all three, as rebuilt, were about forty-two feet in length by about twenty-eight feet in breadth. These three mills and a fourth, Weirhaugh, established in 1797, were each held jointly by four waulker- or dyer-manufacturers. The mill sites were held on ninety-nine year tacks from Scott of Gala⁷².

From 1805 there are signs of certain of these small manufacturers reinforcing their positions by founding new mills. Of these only one, Huddersfield (1818) was jointly financed; the four partners included George Patterson, co-founder of Waulkmillhead, and Robert Walker, founder of Ladhope Mill. Another partner, John Gledhill from Huddersfield, was the only English manufacturer to invest in the Galashiels industry during the period. David and William, sons of William Thomson (co-founder of Weirhaugh Mill), established Linburn Mill in 1805; Richard Lees (co-founder of Mid-mill), established his own mill, Galabank, in 1818 and Robert Sanderson, presumably a relative of Hugh Sanderson (co-founder of Weirhaugh Mill) built Galabank Mill, a three storey sixty-five feet by twenty-eight feet structure, in 1826⁷³.

Through deaths, bankruptcies and other events those mills established jointly before 1805 gradually passed to individual owners. Mid-mill was under the sole control of the Cochranes by 1831, but in most cases the consolidation of ownership was not completed until the 1840's, 50's or 60's⁷⁴.

However, the small waulkers and manufacturers of the late 18th century had already become capitalist manufacturers by the 1830's, and while, at some centres, woollen mills were still taking on custom work, those at Galashiels were producing solely for the open market.

Although the majority of woollen mills were built by small-scale waulker-manufacturers, merchants and manufacturers of more substantial means were involved in a number of projects, most of them large in scale. In some cases woollen manufacturers had already accumulated sufficient funds to make substantial investments at an early stage. David Irving, manufacturer at Whiteshiels, near Langholm, had laid out more than £2,000 on establishing a woollen mill there by 1799, in which year he took in a partner from Kendal and started the firm of Irvine & Co. to manufacture droggets or coatings⁷⁵. In most cases, however, woollen manufacturers were too poorly financed to make such a heavy investment, and where larger mills were built in the years immediately before and after 1800, their backers usually had other sources of mercantile or manufacturing income. Daniel Clark, merchant in Campbelltown, built a woollen mill at Auchalick, Argyll, "on a pretty large scale"⁷⁶, while at Duntocher, Dunbartonshire, the Duntocher Wool Company, a basically mercantile group, established a large woollen mill c. 1787. The Dalnottar Iron Company, from whom the land was sub-let, had a controlling interest in the woollen company and in a second company, established in 1788 on a capital of £8,000⁷⁷. In the 1790's the company was employing over three hundred workers and was capable of producing ^{hundred} one thousand yards of

cloth per annum⁷⁸.

Another early mill, Stoneywood, involved a variety of interests. The two major partners, Charles Baird and Alexander Smith, were respectively a silk buyer and a paper manufacturer; among the other partners were Thomas and Robert Kilgour, manufacturers in Kinmundy, and Thomas Black, druggist in Aberdeen⁷⁹.

Lastly, at least two other large woollen mills in the north-east originated with mercantile interests. James Knowles was a member of a long-established Aberdeen merchant family trading in wool, corn and hosiery. In 1805, while in Rotterdam, he leased Cothal Mills, near Aberdeen, and took one Crombie, a local weaver, into partnership to manufacture high quality woollen cloth for sale through his Dutch contacts. At a later stage the partnership was augmented by Alexander Rhind, an Aberdeen merchant with real estate and shipping interests⁸⁰. An Elgin merchant, Alexander Johnstone, established a woollen mill at Newmill in the late 1790's. According to Gulvin he "dealt in oatmeal, fish, whisky, snuff, tobacco and beer as well as English cloths, and sold flannels on commission for a Rochdale firm, hats for a Manchester business, cloth for Prest's of Leeds, crockery and, for a while, insurance"⁸¹. Although the mill was initially intended to card wool for local needs, manufacturing for the market soon came to predominate. By 1807 he had installed four carding engines, a slubbing billy, four spinning jennies, six broad-looms and a fulling mill, to which he proposed to add a slubbing billy, two spinning jennies, four broad-looms and a second fulling mill⁸². By 1811 Messrs Johnstone & Sim, as the company had come to

be known, were manufacturing two thousand stone of wool into narrow cloth per annum. All processes, from carding to pressing, were carried out at the same works, while four additional carding mills, owned by the company, prepared wool for private individuals in the Moray area⁸³.

The preceding examples, which represent the majority of the large early woollen mills, show the importance of mercantile and manufacturing capital at that time and in that type of mill. However, the impact of these mills was small when compared with those built or occupied by smaller manufacturers or waulkers. Although they were large in terms of physical scale, their contribution to total output was relatively small and numerically they were relatively few. Cothal and Newmills became important long-lasting establishments but Auchalick soon died out, Duntocher was converted to spin cotton and even Langholm, where Whiteshiels mill was situated, went over temporarily to cotton manufacturing⁸⁴.

Their most important role was one of innovation. Cothal Mills and Newmills introduced fine cloth manufacture to their respective areas whilst Duntocher produced worsted. Whiteshiels brought to Scotland a type of cloth previously only manufactured in the Kendal area of Westmorland; Stoneywood brought the carding machine to the north east and Auchalick brought machinery to the west Highlands.

By 1815 many of the manufacturers who had started on very limited means had accumulated sufficient capital or credit to build large mills of their own: in the Hillfoots it was the Archibalds, Patons and Drysdales, at Bannockburn the Wilsons, at Hawick the Nixons, Wilsons, Scotts and Pringles

and at Galashiels the various manufacturing families already referred to. For the merchant manufacturer there were new areas to exploit, but the more successful of the small manufacturers stayed with the woollen industry, eventually taking on the status of large-scale manufacturers.

Tenants and Artisans

In 1790 John Naismith suggested that:

"some good fulling mills, occupied by tenants properly accomplished for the business, would lend greatly to the advancement of the woollen manufactory. Those tenants would not only be capable of giving a good finishing to the cloth, upon which others employed them, but they would be naturally disposed to apply any stock they might be able to command, either in employing people to manufacture woollen cloth, or in purchasing from the little manufacturers in the neighbourhood such raw undressed cloth as might be offered for sale, in order to give employment to their mills"⁸⁵.

To some extent the results which Naismith wished to see were already coming about with the rise of the waulker-manufacturer; before the end of the period his ideas were also to see fruition in a much wider context, with the involvement of lesser waulkers and dyers not only in establishing woollen manufactories but also in building waulkmills.

Waulkmills were built by dyers at Berryscar (Dumfriesshire) in 1799, Fort William (Inverness-shire) in 1808 and Stanleybank (Ayrshire) in 1819⁸⁶. Fullers and dyers installed carding machinery, or even a full set of preparing and spinning machinery, at Kirkconnel (Dumfriesshire) and at Killearn

(Stirlingshire)⁸⁷. The latter mill was still held by the same family some forty years later, by which time four hundred hundredweight of wool per annum was undergoing all processes including weaving⁸⁸. Members of the same trade were responsible for at least five carding mills in Perthshire, of which one, established at Blackford in 1802, was enlarged in 1825 and was manufacturing wool into blankets at the time of the 1834 Factory Commission under the same family⁸⁹. There were doubtless many other instances, especially in areas marginal to large-scale woollen manufacture, but petitions to the Board of Trustees, the most important source of information on such matters, seldom gave details of applicants' backgrounds.

Two other examples from the textile trades show something of the variety of backgrounds from which mill builders might be drawn. James Kirk had been a foreman with the Edinburgh woollen manufacturers Jackson & Co before taking a tack of the waulkmill at Gifford. In 1798 he applied for aid to set up a wool manufacture there or, more specifically, for a carding machine at an estimated cost of £50⁹⁰. It seems unlikely that his plans ever reached fruition for only seven years later there was a second petition, from another person, for a full set of machinery on the same site⁹¹.

About 1800 a West Linton weaver, Alexander Alexander, built a carding mill at Carlops, Peeblesshire, to manufacture coarse Tweeddale wool into felts for Midlothian papermills. According to Findlater he proposed to diversify production into serges and other coarse woollen goods as capital, credit and markets grew⁹².

In a few cases persons described as millers or millwrights established woollen mills. John Miller, tenant of Newmill of Arnbeg (Argyll) added carding machinery to his meal mill c.1811⁹³, whilst at Dunphail Mills (Nairn) William Sutherland, the miller, obtained a grant towards a carding mill in June 1828, only to have it razed to the ground in the floods of the following Autumn⁹⁴.

In Edinburgh an enterprising millwright, Alexander Hamilton, built machinery at St Leonards Hill to grind printers ink and to card wool for hat manufacturers, at a total cost of only £157. The mill's water supply was derived from surface water off the streets of Edinburgh and from springs in the Meadows area⁹⁵.

A variety of circumstances favoured the development of small-scale woollen mills by tenants and artisans. Textile employees already had some knowledge of the trade, millwrights had the requisite skills to construct machinery and millers had leases on buildings and water power which could be applied to driving full, preparing or carding machinery. Waulkers were particularly well placed. On the whole the areas in which tenants and artisans built mills had not yet been monopolised by large-scale manufacturers; the spread of sheep farming, using improved breeds, provided a readily available raw material. Many of their mills involved only a partial mechanisation of wool manufacturing, enabling them to draw upon existing spinning and weaving skills while using their own modest assets to install preparing and carding machinery. However, success stories such as those at Killearn and Blackford were exceptional and despite the survival of many of these mills through most of the 19th

century, there were new applications for aid after 1810, suggesting that in wool, as in linen, the early years of the 19th century belonged not to the artisans, mill tenants or other small men but to larger, better financed manufacturers.

The Board of Trustees

The demand for and the supply of Board of Trustee funds for the woollen industry contrasts strongly with the situation in the linen industry. In the latter, only very limited funds were made available for mill-spinning, and these during the earliest years of its development. Finance for the woollen industry however, grew from very small proportions to oust bleachfields and lint mills as the largest sector of the Board's expenditure.

Initially the Board was reluctant to provide help: in 1793 it turned down George Mercer's first petition for aid towards a waulkmill and only accepted a second one on the strength of recommendations from Scott of Gala and Pringle of Torwoodlee⁹⁶. A similar application from Robert walker in 1788 was turned down despite recommendations on the grounds that the Board was "not in the practice of assisting in the erection of waulk mills"⁹⁷. However, within a few years the Board had begun to look more favourably on the reviving woollen industry, and continued to make a contribution to financing buildings and machinery until the 1830's.

The decision to back the woollen industry rather than linen owed something to the Board's attitudes towards imported raw materials, scale of unit and spatial distribution.

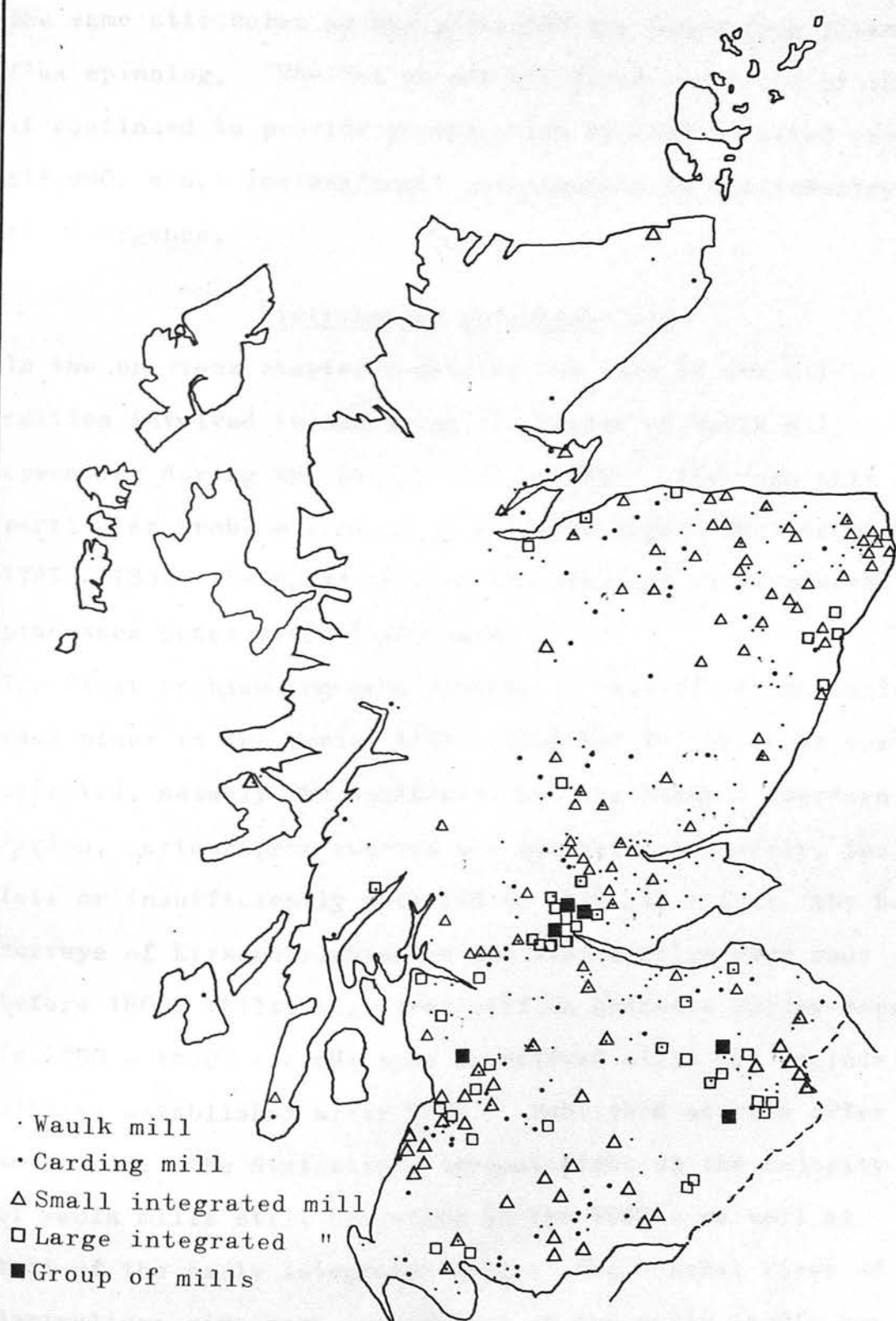
Until the early 1800's the woollen industry used a raw material largely produced in Scotland. In both the southern Uplands and the Highlands improved breeds of sheep, notably the Cheviot and the Blackface, enhanced the quality and increased the quantity of wool available. In the Highlands the process whereby sheep replaced cattle and people alike, had commenced on a few estates during the late 18th century and accelerated in the early 19th. This also encouraged, if not guaranteed, the involvement of Scotland's landowners, a group favoured by the Board of Trustees and one whose active co-operation had been sought over a prolonged period. Their backing for a project could persuade the Board to loosen its purse-strings and where a landowners co-operation was not already forthcoming the Board could stipulate it as a pre-condition for financial aid.

With regard to the second characteristic, scale of unit, the woollen industry in its early stages of mechanisation usually involved small units which were inexpensive to establish and which could be set up and run by people of limited means. Consequently, the limited funds at the Board's disposal could be used to the benefit of a large number of sites over a wide area. There was also the possibility of partial mechanisation; the Board can hardly have failed to have noticed the decline in hand spinning brought about by the mechanisation of cotton and flax spinning, and while a handful of mills were built to card locally grown tow the potential for wool carding mills was considerably greater. This attribute of the woollen industry was particularly significant for the Highlands, where the Board had previously shown reluctance to introduce processes which might reduce rather than increase employment.

Initially the Board favoured small units, even to the extent of declining to help more expensive projects, but gradually the scale of finance increased as individual units became larger and more expensive, until by the 1820's the Board was regularly paying out sums of £100 or £200 to projects costing £1,000 to £3,000.

Closely related to the question of scale was the dispersion of the industry. Since widely available raw materials could be partially or totally manufactured by relatively inexpensive machinery in small mills, there was a steady process of diffusion which was still going on in 1830. By that time woollen mills of one kind or another had become well established in and adjacent to most upland areas as far north as Lewis and Caithness (figure 19.2). This fitted in well with the Board's long-standing preference for dispersion rather than concentration. Unfortunately, in pursuing its policy the Board tended initially to back projects of doubtful viability in outlying areas rather than supporting other, more economically sound ventures in established manufacturing centres. Before long, however, this policy, like that on scale of unit, had been dropped in recognition of the need to subsidise repeated heavy investment on individual mills. Assistance was given not only to several mills in any one area but also to the same mills on more than one occasion.

Initially flax spinning, with its imported raw materials, its heavy capital investment, its large units of production and tightly defined distribution presented quite a different set of characteristics. However, the features which favoured



wool rather than linen in the eyes of the Board of Trustees were already losing significance in the 1820's as the more highly developed sectors of the woollen industry took on the same attributes as had prevented the Board from financing flax spinning. Whether or not the Board was aware of this it continued to provide grants which by 1830 totalled over £18,000, a not insignificant contribution to the industry's re-assurgence.

Distribution and Chronology

In the previous chapter something was said of the difficulties involved in assessing the number of waulk mills operating during the period 1730 - 1785. Although this particular problem applies to a lesser degree for the period 1785 - 1830, the broadening of the range of water-powered processes poses several new ones.

The first problem concerns sources. Most of the mechanisation took place in the period 1800 - 1830 but in the areas most affected, notably the south-west and the Moray - Aberdeen region, cartographic sources are generally too early, too late or insufficiently detailed to show all sites: the best surveys of Kirkcudbrightshire and Wigtownshire were made before 1800, whilst the first edition Ordnance Survey maps (c.1850 - 1880) exclude some shortlived mills but include others, established after 1830. Published sources offer more help: the Statistical Account picks up the majority of waulk mills still operating in the 1790's as well as most of the early integrated mills; the General Views of Agriculture give some information on the early 1800's but with few exceptions fail to identify sites individually.

The New Statistical Account gives a good breakdown of sites to parish level but again often fails to give their status and exact location. The best source by far is the Minute Books of the Board of Trustees, but even here there are pitfalls. While they give details of the machinery proposed and the grants offered to a great many mills, they fail to indicate whether the machinery was ever installed or whether the grant was taken up. In some cases confirmation comes from other sources, but in several instances there is equally strong evidence that some projects were never realised. The second problem concerns the status of mills. Between a small country waulk mill and a large, fully mechanised spinning mill there is a wide range of mills for scribbling, carding, jenny spinning, mule spinning and combinations of these. Furthermore the scale of carding and spinning mills could vary enormously from a single storey mill with one carding engine to a three or four storey mill with several carding engines and spinning mules. To use the available sources to the best advantage it is necessary to separate out different types of site. Waulk mills, being the longest established, will be considered first and will be followed by carding mills, then spinning mills. Within each group a chronological division will be used to give some indication of developments through time.

Waulk Mills

From cross-referencing between maps of the 16th to 19th centuries it would appear that a considerable number of earlier waulk mills were still in use during the period 1785 - 1830. At the same time it is also apparent that

a number of mills were lost completely during the low ebb in the woollen industry in the first three quarters of the 18th century, or were converted to other purposes such as flax scutching.

In the 1780's and 1790's a few new mills were set up: Cluny (1789) in Aberdeenshire, Tillicoultry (1790) and Alloa (1794) in the Hillfoots, Wilderhaugh (1783), Buckholmside (1788) Dryburgh (1789) and Innerleithen (1790) in the Borders and Moffat (1796), Kirkinner (1797), Langholm (1799) and Berryscar (1799) in the south west all belong to this group⁹⁸. As waulkmills and the woollen industry in general were already well established in these areas, this implies that the industry was growing or that the use of fulling in cloth manufacture was on the increase. The real situation probably involved both elements. In all the areas concerned wool from improved breeds of sheep was either grown or manufactured. There is good reason to believe that the influence of waulker-manufacturers was on the increase and that several of the waulkmills which they established during the 1780's and 1790's were, or were to become, part of integrated mills where carding and latterly spinning were also performed by water power. At one major centre of innovation, Galashiels, four out of the five waulkmills had already been incorporated into integrated mills by 1800⁹⁹. In all of these areas, but particularly in Aberdeenshire, the survival of earlier waulkmills is apparent. The Statistical Account contains several references to existing waulkmills in Fife, Angus and Perthshire but little evidence of new ones. Many of the established mills had probably been adapted for washing linen yarn (i.e. plash

mills): at least one new waulk mill, at St Andrews, was intended primarily for this purpose¹⁰⁰. In Ayrshire and the west of Scotland there is little sign of activity during the 1780's and 90's. In Ayrshire there were probably sufficient mills already and an early specialisation in carpet manufacture might go some way towards explaining the lack of new mills. Over the whole area cotton had become the major textile industry, while in the more isolated areas flax was still of some importance. The Lothians were still an important wool manufacturing area, with a substantial number of existing waulkmills. Nevertheless, the lack of new developments suggests a relative decline in the area's status. In the Highlands there was not as yet any sign of the waulkmill extending its range into areas of manual waulking.

By the early years of the 19th century the only waulkmills still being built in the Borders and Hillfoots were those which formed parts of integrated mills. With the move towards production for market, the industry tended to concentrate in those areas with mechanised carding and spinning facilities; at the same time it seems likely that there was a corresponding decline in custom work and the waulk mills which catered solely for it. In the north-east, Galloway, Stirlingshire and West Perthshire there was a slight increase in the number of waulk mills and while some were integrated with carding mills, these were not generally so large-scale nor so market-orientated as the integrated mills of the Borders and Hillfoots. Alongside a revival in the woollen industry there was a

decline in the linen industry in these areas; the reduction in home cultivation of flax, the extension of sheep farming and the mechanisation of wool carding all contributed to a transfer of weaving skills from linen to wool and a corresponding increase in the demand for the services of waulk mills. In Galloway the cotton industry which had shown signs of developing in the late 18th century was also in decline.

In Fife, Angus and east Perthshire flax still dominated textile manufacture, whilst in west central Scotland a similar situation pertained with regard to cotton. In both areas there was very little new waulk mill building except on upland margins and there was probably a net decline in numbers operation. The Lothians too saw a decline in numbers but a few new mills were being built in parts of the Highlands where formerly there had been none.

Between 1815 and 1830 the trend towards centralisation in the Borders and Hillfoots continued. In the north-east a few new mills were built and carding machinery added to, or substituted for, existing fulling machines. Developments in Galloway followed similar lines although here there may have been a small net decline. The relative importance of east central and west central Scotland continued to fall, with a consequent reduction in the total number of mills, but in Ayrshire a few new ones were built as individual units for small manufacturers in the south or as components of integrated mills in the north. In both districts of Ayrshire the flax industry underwent further decay while in the north of the county the influence of cotton was also waning.

In west Perthshire and Stirlingshire the revival which had begun between 1800 and 1815 continued to gain strength; in the more isolated areas waulk mills were built as individual units or with carding machinery, but in more accessible areas, such as Bannockburn, they formed part of integrated mills. In the Highlands the waulk mill continued to break new ground, and by 1830 it had spread as far as the Outer Hebrides.

Changes in the distribution and numbers of waulk mills between 1785 and 1830 may be summarised as follows. In the Borders, Ayrshire and the Hillfoots there was a net increase in numbers but within each area fulling tended to concentrate in those centres where carding and spinning also took place. The Highlands saw a small net increase involving a widening distribution of individual waulk mills; west Perthshire and Stirlingshire experienced a similar increase only here it was in connection with small manufactories. In Galloway and the north east there was a rough stability in numbers, with some re-siting and the development of small integrated units around waulk mills. In the Lothians there was a net decline, despite the failure of linen and cotton industries to take root, but in east central and west central Scotland the success of linen and cotton respectively may have contributed to a decline in waulk mill numbers in all but upland areas.

In all there were probably about 300 waulk mills operating in Scotland between 1785 and 1830, including those in integrated mills (figure 19.2).

Carding Mills at a number of carding mills by means of

From its introduction in 1790, the carding mill soon spread across the established wool manufacturing districts of Scotland. Carding machinery appears to have arrived almost simultaneously at four separate localities, Innerleithen, Duntocher, Galashiels and Stoneywood¹⁰¹, but only in the case of Stoneywood is it possible to identify a subsequent process of diffusion¹⁰².

By whatever means, carding machines had spread to a few dispersed sites by 1800, mostly in the Galloway - South Ayrshire area and the Borders, but also in the Hillfoots, the north east, along the Moray Firth to the Black Isle and the more accessible parts of Highland Perthshire. In the central Lowlands linen and cotton still held sway but the latter, which had been established in Galloway, was already on the decline there, as is witnessed by the decision to install machinery for wool rather than cotton at Old Kirkchrist, Kirkcudbrightshire¹⁰³. By 1800 there were already carding mills in each of the areas which were subsequently to dominate the Scottish industry and some sites, notably in the Borders, were to become integrated mills. Even so, there were probably no more than twenty-five machines in the whole country at that time.

Between 1800 and 1815 at least three tendencies can be determined in the distribution of carding mills. In those areas such as the Borders, where they had gained a strong footing by 1800, there was a move towards the accretion of other manufacturing processes to the existing carding mills and the creation of new integrated mills. Spinning, which had

been performed at a number of carding mills by means of hand-driven jennies, was first adapted to water power at Galashiels in 1814.

In areas such as Highland Perthshire and the Moray Firth Lowlands, where perhaps one or two mills had been established before 1800, there was a process of consolidation with more carding mills being built. The third process involved the colonisation of, on the one hand, areas such as Stirlingshire and north Ayrshire, where linen or cotton had formerly been the predominant textile industry and, on the other hand, areas which had formerly had little organised industry, such as the northern central Highlands. Growth in the former area was much more marked than in the latter.

In reality developments were by no means so distinct as the preceding account suggests, for in any one region at least two of these processes might be at work. Thus, in the Borders colonisation was taking place in the upper reaches of Tweeddale at the same time as accretion in manufacturing villages such as Galashiels, whilst in the Moray Firth area Elgin had fully integrated Newmills at the same time as colonisation was taking place in upland areas¹⁰⁴. Between 1800 and 1815 carding machinery was installed in at least one hundred and twenty mills in Scotland.

Between 1815 and 1830 the regions where integrated mills were already established gained in strength and, generally speaking, carding machinery was only installed as a component of integrated mills. The process of accretion had, therefore come to a temporary end, although new integrated mills were still being built and the process was to start afresh after

1830 with the mechanisation of weaving. Elsewhere there was little evidence of consolidation but further colonisation was quite apparent. In the west cotton industry was becoming increasingly nucleated as the centripetal force of Glasgow grew; this is reflected in the establishment of woollen mills in north Ayrshire, most of them integrated and at least one, at Dalry, housed in a former cotton mill¹⁰⁵. In the east a similar process of substitution was taking place in areas marginal to the linen industry which, like cotton, was becoming increasingly centralised, in this case on Dundee. New mills were established in Kincardineshire, the Lothians and even west Fife¹⁰⁶. Colonisation in the Highlands gained a greater momentum than it had achieved before 1815, with particularly marked development in the eastern and northern Grampian, with one site as far west as Stornoway¹⁰⁷. Generally speaking these Highland mills contained only carding machinery, although several had hand jennies and a few had waulk mills. Between 1815 and 1830 carding machinery was installed in at least one hundred mills, and during the entire period 1785 - 1830 there were no less than three hundred mills with carding machinery, including those already established as waulk mills and those containing spinning machinery. Throughout the period hardly any carding mills were established in the Glasgow area or in Fife and Angus, the respective centres of the cotton and linen industries.

Spinning Mills

The distribution of water-powered wool spinning mills is particularly difficult to define. As has already been

pointed out, a number of carding mills had hand-powered machines for spinning or even for weaving while a few, from an early stage, performed all operations in the manufacture of woollen cloth without using water power for any process except preparing and fulling. Furthermore, since water-powered wool spinning was not perfected until 1814, only those areas in which wool manufacture was well established had adopted the new method by 1830. The most helpful approach is to work backwards from a period when distributions and numbers are well known. The 1838 Factory Returns¹⁰⁸ list a total of one hundred and twelve woollen mills, of which about a hundred were partially or totally water-powered. Discounting those mills built after 1830, including those in northern Scotland, such as Holm Mill, Inverness, and Newmill, Elgin, which were not enumerated, and taking into account any mills which might have gone out of production between 1814 and 1830, one arrives back at a total of about 100 for the period up to 1830. In contrast to the wide distribution achieved by waulk mills and carding mills, that of spinning mills was strongly nucleated in the principal centres of the industry - the Borders, Ayrshire, Galloway, the Hillfoots/Stirling/west Perthshire area and eastern Aberdeenshire (figure 19.2). Within these areas nucleation was most apparent in the Borders (Galashiels and Hawick had ten mills each) and the Hillfoots. At the other extreme, few communities in south Ayrshire had more than one mill. As one might expect, these areas coincide with those in which the Board of Trustees was making the heaviest investment between 1814 and 1830. During the period 1785 - 1830 at least five hundred water-

powered woollen mills of one type or another were operating in Scotland (figure 19.2)

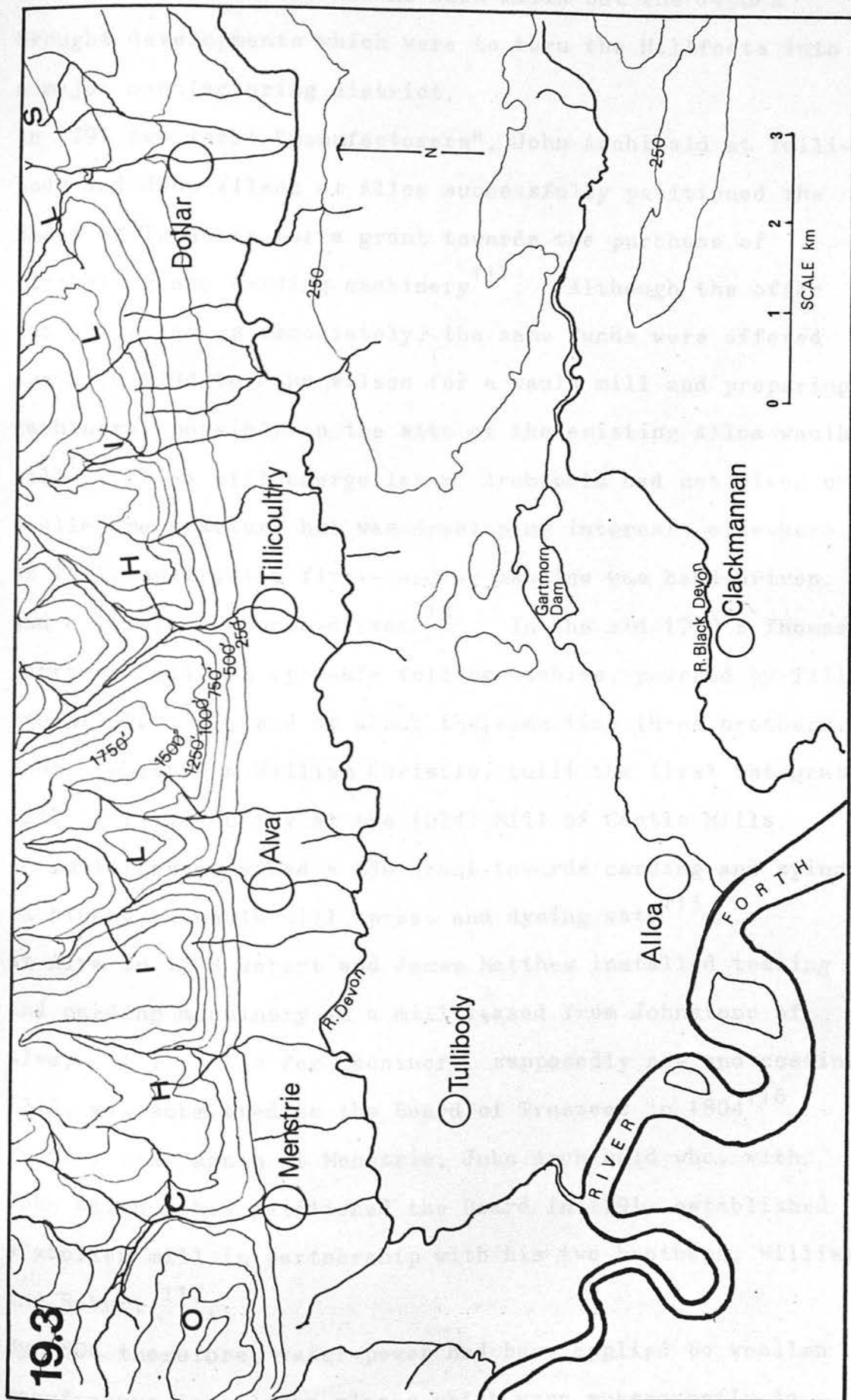
Case Study: Hillfoots Woollen Mills

Introduction

The choice of a site for more detailed consideration is not an easy one to make. The concentration of mills in certain favoured districts suggests that an examination of a small area would be more revealing than one concerned with an individual site; of the potential areas of study, Gala-shiels provides the best instances of innovation and had the most mills, but the consideration already given to it in this chapter and by other writers, such as Hall¹⁰⁹ would make a second account repetitive. Hawick, the other major woollen centre in the Borders, has been written about to a lesser extent, but still lies within an area which is comparatively well documented. In contrast, relatively little is known of the Hillfoots district which, with twenty mills within a five-mile radius, was second only to the Borders as a wool-manufacturing centre. In view of this poor state of documentation for such an important area, the Hillfoots district is an obvious choice for a case study of Scottish woollen mills between 1785 and 1830.

Historical Background

By the late 18th century Clackmannanshire, or more precisely, the Hillfoots district, (figure 19.3) already had a small woollen industry based on serges and although Stirling had traditionally been the local centre for woollen manufacture, Alloa had its own waulk mill by 1785 and Dollar parish had two by the 1790's¹¹⁰. As yet the villages of Menstrie,



Alva and Tillicoultry had no such mills but the 1790's brought developments which were to turn the Hillfoots into a major manufacturing district. In 1791 two local "manufacturers", John Archibald at Tullibody and John Wilson at Alloa successfully petitioned the Board of Trustees for a grant towards the purchase of scribbling and carding machinery¹¹¹. Although the offer was not taken up immediately, the same funds were offered again in 1794 to John Wilson for a waulk mill and preparing machinery, possibly on the site of the existing Alloa waulk mill¹¹². As will emerge later, Archibald had not given up woollen manufacture but was developing interests elsewhere. At Tillicoultry the first carding machine was hand-driven and a later one horse-driven¹¹³. In the mid-1790's Thomas Harrower built an open-air fulling machine, powered by Tillicoultry Burn¹¹⁴, and at about the same time three brothers, John, Duncan and William Christie, built the first integrated mill in Tillicoultry at the (Old) Mill of Castle Mills. In 1801 they obtained a £50 grant towards carding and spinning machinery, a waulk mill, press and dyeing vats¹¹⁵. At Alva in 1798 Robert and James Matthew installed teasing and carding machinery in a mill leased from Johnstone of Alva. A petition for machinery, supposedly new and costing £335, was submitted to the Board of Trustees in 1804¹¹⁶. Further west again at Menstrie, John Archibald who, with John Wilson, had petitioned the Board in 1791, established a woollen mill in partnership with his two brothers, William and Robert¹¹⁷. By 1800 therefore, water-power had been applied to woollen manufacture in all the places which were subsequently to

to achieve such importance. The application of machinery so soon after its introduction to Scotland shows an initiative on the part of small manufacturers similar to that found in the Borders, but although good falls were available, the volume of water was small, a factor which was to be of significance in the industry's later development.

1800 - 1830

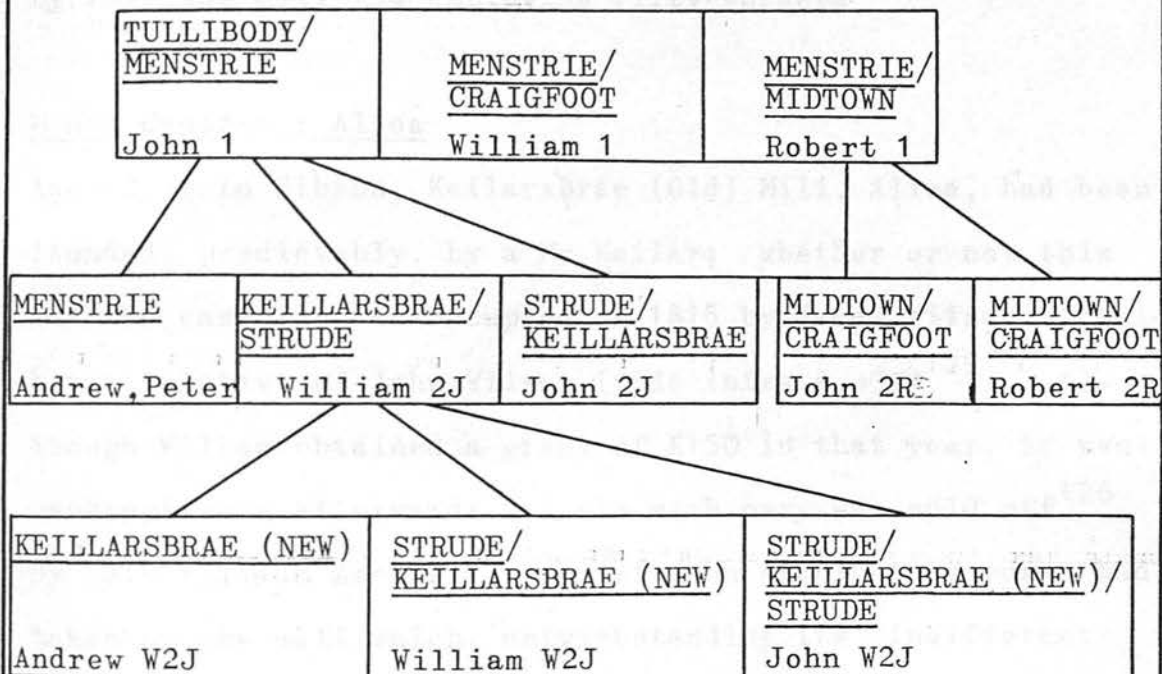
Minor Centres : Menstrie

Although no further water-powered mills were established at Menstrie, the Archibalds' mill continued to grow. William left in 1806 to establish his own mill at Tillicoultry and Robert took on an existing mill in 1817, leaving John and two of his sons, Peter and Andrew, to run the mill at Menstrie (figure 19.4)¹¹⁸. Two other sons, John and William, ran other woollen mills in the Hillfoots area. The Menstrie mill was extended to the east in 1810 and in 1813 John Archibald obtained a grant for machinery from the Board of Trustees¹¹⁹. A second application, for a further £150, was submitted by Andrew Archibald in 1816 but by 1810 he had emigrated, leaving the mill in his father's hands once more¹²⁰.

The grants had apparently been put to good use; when the mill was visited in 1819 it housed three teasing machines, three scribbling machines, three carding engines, six slubbing billies, two jennies, three reeling and twining machines, ten looms, two waulk mills and twelve pairs of shears¹²¹. However, the meagre water resources available to the mill could not drive this and additional machinery; by 1834 steam power had been installed and the irregular supply of water provided no more than half of the required 10 horsepower.¹²²

19.4

The Archibald Family



Mill Names: Upper Case

Personal Names: Lower Case

Over the years the mill's products changed, for although it was already making blankets and plaidings in 1819, the serges and coarse cloth, traditional products of the district which the mill still made then, had given way to shawls by 1834¹²³. By 1841 the mill was employing fifty workers¹²⁴.

Minor Centres : Alloa

According to Gibson, Keilarsbrae (Old) Mill, Alloa, had been founded, predictably, by a Mr Keilar; whether or not this was the case, it was occupied in 1815 by James Wilson, possibly a relative of John Wilson (vide infra p.437)¹²⁵. Although Wilson obtained a grant of £150 in that year, he went bankrupt soon afterwards and the machinery was sold off¹²⁶. By 1819 William Archibald, one of John Archibald's sons, had taken on the mill which, notwithstanding its "indifferent looking" appearance, housed an excellent set of machinery, covering all processes from teasing to fulling¹²⁷. £105 of the total cost had been covered by a Board of Trustees grant¹²⁸. During his occupancy, William added two storeys to the existing single storey mill¹²⁹.

While William had been at Keilarsbrae Mill, two of his sons, John and William, had been at their uncle John's mill at Alva (figure 19.4). At some stage John senior and William senior changed places and subsequently William senior built a second mill at Keilarsbrae, referred to as Keilarsbrae New Mill, for John and William junior and a third son, Andrew. When this failed one of the sons, John, rejoined his father at Alva¹³⁰.

From the preceding account it should already be evident that the activities of the Archibald family were extremely complex.

According to the 1834 Factory Commission Report, Keillarsbrae Mill, occupied by William Archibald, had been built in 1821 and enlarged in 1824 and 1831. As John (senior's) mill at Alva was not built until 1825, this probably refers to the earlier of the two mills at Keillarsbrae, in which case 1821 would be the date at which the additional two storeys were built. If one were to assume this, Keillarsbrae New Mill was not founded until after 1834, and was probably steam-powered¹³¹. The Keillarsbrae Mill referred to by the Factory Commission derived a steady six horse power from water power, with a reservoir to regulate the flow during dry spells. No steam power was required¹³². In 1819 the mill had specialised in carpet and stocking yarns but by 1834 it had moved over to blankets and worsteds¹³³. Besides the Keillarsbrae mills, Alloa had only one other water-powered woollen mill, Kincraig, established in 1812, first used for woollen manufacture in 1814 and enlarged in 1819¹³⁴. John Paton, the mill's founder, was a member of what was later to become an important wool manufacturing family; in 1816 he obtained a £150 grant¹³⁵ which seems to have been well employed, for the 1819 report comments on the "excellent machinery" which performed all processes from teasing to fulling. At this stage the mill was doing a thriving trade in yarn for carpet weavers and coarse country cloths¹³⁶, but here again there was a move towards more market-orientated production and by 1834 it was specialising in stocking yarns. As elsewhere in the Hillfoots, difficulties had arisen over water supplies, for although the mill had ten horse power for most of the year, only half as much was available during dry summers while in prolonged droughts

the stream had been known to dry up completely for two or three weeks at a time¹³⁷. It should be borne in mind, however, that in submitting evidence to the Factory Commission manufacturers wished to emphasise the need for long working hours; had the position at Kinbraig been really serious, a steam engine would have been installed long before 1834¹³⁸.

Minor Centres : Dollar

Despite its long associations with the woollen industry, the textile manufactures of Dollar were dominated in the early 19th century by the extensive bleachfields which specialised in bleaching table linen for Dunfermline manufacturers¹³⁹. The first woollen mill was built c.1805 by Messrs Gibson, Pitcairn and Burns, under the management of William Wilson¹⁴⁰. In 1806 Robert Pitcairn & Co. were offered £65 towards existing carding and spinning machinery and for a double carding engine, a billy and two jennies yet to be installed¹⁴¹. This first mill was demolished c. 1818 to make way for a second one¹⁴².

Dollar's second woollen mill reflected the general move from custom work to manufacturing for the market: the first mill had carded and spun country wool¹⁴³ but its successor, built by William Drysdale, the son of an Alva woollen manufacturer, performed all processes from carding through spinning and weaving to fulling. By 1821 over £400 had been invested in machinery, £55 of which had come from the Board of Trustees¹⁴⁴. Water provided six horse power but was described in 1834 as irregular. By the early 1840's the mill had become a subsidiary of an Alva mill and was concentrating on carding and spinning¹⁴⁵.

While Menstrie, Alloa and Dollar could be described as wool manufacturing communities, it was at Tillicoultry and Alva that the industry took on most successfully and it is to these two that attention must now turn.

Major Centres : Tillicoultry

Despite Tillicoultry's long-standing associations with woollen cloth manufacture, the industry had reached a low ebb by the 1790's. At that time there were only twenty-one weavers in the parish and, according to the stampmaster, only seven thousand yards of serge and an equal quantity of plaiding passed through his hands each year¹⁴⁶.

The first signs of revival came in 1798 when John Christie, "an ingenious and energetic native of the village", with two of his brothers, Duncan and William, built a woollen manufactory at Old Mills of Castle Mills¹⁴⁷. In 1801 they obtained £50 from the Board of Trustees towards a waulk mill, press, dyeing vats and carding and spinning machinery¹⁴⁸.

Initial successes prompted the Christies to build a second mill, Midtown, c.1805, towards the machinery of which £67 was granted in 1807¹⁴⁹; the success was, however, short-lived. In 1815 William Christie, who appears to have taken overall control of the mills, obtained a grant of £150.

In all probability the money was needed to pay off debts on capital investment or to finance an over-ambitious project; whatever the case William Christie went bankrupt shortly afterwards and emigrated to America¹⁵⁰. Thereafter the mills lay empty for a year or two¹⁵¹.

In the meantime, since the founding of Midtown Mill, other mills had been built in the village. It has already been

stated that William Archibald left Menstrie Mill in 1806 to start his own mill at Tillicoultry (p. 438). The mill in question was Craigfoot, on the very edge of the Ochils at the upper end of the village. To secure an adequate water supply, Archibald had to build a new dam high up in the glen with a very long lade, part of which ran twenty feet below ground level¹⁵². According to Gibson, women in the village, objecting to pollution from Craigfoot's waulk mill, twice demolished the dam under cover of darkness before arrangements were finally made to carry off the polluted water in a sewer¹⁵³.

William Archibald died in 1826 but the mill was carried on for a further thirteen years by his widow. In 1838 it was replaced by a new mill with a thirty-five foot diameter water wheel¹⁵⁴.

Tillicoultry's fourth mill, referred to by Gibson as the "horse mill" or "company mill", was established above Castle Mills in the early 1810/s by a group of Alva-based manufacturers under the firm of James Balfour & Co¹⁵⁵. On this site the company built a waulk mill and probably other water-powered machinery. Although little is known of the mill's early history the company, still intact despite changes in membership, obtained grants in 1822 and 1829 totalling £131 towards carding, spinning, weaving and fulling machinery costing £727¹⁵⁶. As it stood in 1833 the mill was of three storeys. Seventy-five feet by thirty-four feet, with a tiled roof¹⁵⁷. The next mill was founded by James Dawson, a local woollen manufacturer, on a site adjacent to Craigfoot Mill. Gibson dates it to 1811 or 1812, but evidence from the Factory commission and the Minutes of the Board of Trustees suggests that

it was not built until 1821¹⁵⁸. At the mill, Dawson installed a full set of preparing, spinning, weaving and fulling machinery at a cost of £554, £85 of which was borne by the Board of Trustees¹⁵⁹. In 1827 additional machinery costing £400 and two new water wheels were about to be added to the mill¹⁶⁰. By Hillfoots standards Dawson's mill, with seven or eight horse power, was moderately well endowed with water power¹⁶¹; it was still in the family in 1834, producing blankets, plaidings and tartan shawls¹⁶². Before proceeding any further, attention should return to Tillicoultry's first two mills which were left with the bankruptcy of William Christie in 1815.

In 1817 the Christies' Midtown Mill was purchased by Robert Archibald, co-founder of Menstrie Mill¹⁶³. Here Archibald installed a new set of machinery (figure 19.5), for which a grant of £75 was awarded¹⁶⁴, and although the mill-house was described as "poor" in 1819, some improvements were made in 1821 and 1826¹⁶⁵; Robert Archibald continued to operate the mill with his two sons, Robert and John. In 1839 they were among the first woollen manufacturers to make use of William Smith's self-acting mule, and in the same year John and Robert took over Craigfoot Mill, which had been run by their uncle William's widow¹⁶⁶. The new company, J. & R. Archibald, continued for several years; John Archibald died in 1848 and in 1851 the mill finally passed out of the family¹⁶⁷.

In 1819 Midtown Mill was producing coarse cloth for local use¹⁶⁸, but it seems probable that some change in products and markets had taken place by the 1830's. Although there were the usual problems with water supply, no steam engine

19.5

Board of Trustees. 1819 Woollen Mill Survey. Hillfoots

	1	2	3	4	5	6	7	8	9	10
Year Aided	1813	1816	*	1814	*	1815	1818	1816	1815	1819
Sum	£90	£150	£50	£65	£80	£150	£75	£150	£150	£105
Teas. mach's.	3		1	1	1	1	1	1	-	1
Scrib. "	3		2	2	1	3	1	1	-	1
Card. "	3		2	2	2	2	1	2	-	1
Slub. "	6		3	3	1	4	2	1	-	1
Sp. Jennies	2		-	-	4	-	1	4	-	4
Reel. & Twin. "	3		1	2	1	1	1	2	-	1
Looms	10		6	8	6	8	6	3	-	3
Waulk mills	2		1	-	1	2	1	1	-	1
Dye-houses	1		-	-	-	-	-	-	-	-

1: John Archibald, Menstrie

&

2: Andrew Archibald, Menstrie. All belongs to John Archibald

3: W. & R. Harrower, Alva. Formerly J. Harrower & Sons.

4: R. Drysdale & Son, Alva

5: Wm. & David Drysdale, Alva

6: Wm. Christie, Tillicoultry. Bankrupt. Gone to America

7: Robert Archibald, Tillicoultry

8: John Paton, Alloa

9: J. Wilson, Keillarsbrae. Bankrupt. Machinery sold.

10: William Archibald, Keillarsbrae

had been installed by 1834 to supplement the four to seven horse power available from the burn¹⁶⁹.

The earlier of the Christies' two works, the Old Mill of Castle Mills, also found a new occupant in 1817. Robert Walker had founded a mill in Galashiels but had been forced to sell to creditors in 1811. Some six years later he reappeared at Tillicoultry, and installed a full set of machinery at Old Mill of Castle Mills at an estimated cost of £386, £80 of which was provided by the Board of Trustees¹⁷⁰. In 1820 or, more probably, 1824 his eldest sons, James and George, founded a new mill, with machinery costing £682; additional machinery, costing £583 was installed c.1830¹⁷¹. The dimensions of the mill were given in 1833 as seventy feet by thirty-two feet by thirty feet high, but despite its size the mill had only an irregular eight horse power at its disposal. In 1834 it was producing blankets, plaidings and tartan shawls, the last of which had been introduced to Tillicoultry some ten years earlier¹⁷³. Andrew Walker, younger brother of George and James, established another mill, the New Mill of Castle Mills, in the late 1820's and laid out £170 on its machinery¹⁷⁴. In 1825 James and David Paton, members of the important wool-manufacturing family, had built a mill at Tillicoultry to produce soft tartan shawls, blankets and twilled flannels¹⁷⁵. Thus, between 1795 and 1830, Tillicoultry had been transformed from a small village, in which a little cloth was produced by hand, to a thriving manufacturing town, with eight large woollen mills producing a range of products

which included fashionable shawls and tartans of high quality. At the time of the New Statistical Account the woollen industry in Tillicoultry consumed 30,000 stones of wool per annum and employed three hundred men, one hundred and twenty women and one hundred and forty children¹⁷⁶.

Major Centres : Alva

In the late 18th century when the manufacture of serges at Tillicoultry was at a low ebb, the same product was being successfully produced at Alva, despite initial customer resistance. Indeed, production at Alva was confined to serges and blankets until the introduction of shawl manufacture in 1829¹⁷⁷. Unfortunately the industry at Alva is not so well documented as at Tillicoultry.

Little is known of the origins of Alva's first mill but it is known to have been acquired later by the Drysdale family who had founded the village's second mill in 1802. By 1814 machinery grants had been awarded to two branches of the family, Robert Drysdale and Son and William and David Drysdale. According to the 1819 report both mills made blankets and coarse cloth for country use, both had a full set of preparing, spinning and weaving machinery, but only William & David Drysdale's mill had fulling machinery¹⁷⁸; of an additional £418 laid out on this mill during the early 1820's, £65 was met by the Board of Trustees¹⁷⁹.

William Drysdale Junior, who may have belonged to either branch of the family, received £155 in two machinery grants during the 1820's, and was running two mills in Alva by 1834, one being the town's first mill, the other a mill built by him c.1827. Both mills had an irregular ten

horse power water supply but no steam power¹⁸⁰. William Drysdale junior had also established the second mill in Dollar c.1818.

By 1834 the Drysdales' first mill, built in 1802 and added to in 1820, was under the firm of William Drysdale and Sons, but here too it is not clear how this William Drysdale was related to the rest of the family. Yet another member of the family, Thomas Drysdale, spent £421 on machinery at Alva in 1829 and obtained a grant of £84 from the Board of Trustees; this machinery might have been installed at a new or existing mill. David Drysdale had been one of the partners in the Company Mill, Tillicoultry¹⁸¹.

There is evidence, therefore, of the Drysdales building two, or possibly three mills at Alva, and occupying another, already built. Much more research would be required before the family's business interests could be disentangled.

In comparison with the Drysdales' activities, the rest of the Alva woollen industry is relatively straight-forward.

In 1807 James Harrower & Sons established a mill at Alva, a grant of £50 being made towards the machinery; a further £90 was given to their successors, William and Robert Harrower, in 1817¹⁸². According to the 1819 report, buildings and machinery were both excellent¹⁸³.

At the Harrowers' mill, as at others in Alva, the products at that time consisted of blankets, plaidings, serges and coarse cloth, but by 1833 worsted shawls were being produced as well¹⁸⁴.

Another mill in Alva was occupied in 1821 by James Ritchie, William Rennie and James Balfour, three of the principal partners in the Company Mill, Tillicoultry¹⁸⁵. A seventh mill, Strude, was established in 1825 by yet another member

of the Archibald family, and started production on 12th April 1826¹⁸⁶. Initially it was occupied by John Archibald, son of the Menstrie Mill co-founder of the same name¹⁸⁷. For a while his two nephews, William and John, were also at Strude, but their father, William, who had been at Keillarsbrae Old Mill, changed places with his brother John at Strude and founded Keillarsbrae New Mill for his two aforementioned sons and a third son, Andrew. When this proved unsuccessful one of the three brothers, John, returned to Strude Mill, now occupied by his father¹⁸⁸. In 1834 Strude Mill was producing yarn for shawls. *After 1830. Prior to 1830 the* These then are the seven mills known to have existed in 1838. By the time the New Statistical Account was written, an eighth mill had been built; at that time the mills consumed 480,000 lbs of wool per annum and gave employment to five hundred and sixty-five people¹⁸⁹.

In the Hillfoots as in the Borders, the backbone of the woollen industry was made up of initially small-scale manufacturers. While they were not as quick as the Borders in taking up new machinery, they did manage to build up a substantial coarse cloth manufacture and had sufficient business acumen by the late 1820's to transfer into more profitable lines such as shawls and tartans, just as manufacturers in the Borders had moved into tweeds.

There was, however, at least one major difference between the two areas: whilst the Borders possessed abundant water power, that available to the Hillfoots was very limited. On the other hand the latter area was situated adjacent to coalfields, and could therefore use auxiliary steam-power more cheaply than could the Borders. At Alva a dam was

constructed to store water, but despite this measure the average fall there produced only six horse power in 1838; the average for Tillicoultry at seven point seven was little better¹⁹⁰. These compared poorly with averages of eight point four at Galashiels, fifteen point five at Hawick and seventeen point three at Selkirk¹⁹¹. It is therefore hardly surprising that steam power was applied much earlier and more generally in the Hillfoots than in the Borders, although the evidence given to the Factory Commissioners suggests that those mills which installed steam engines did so only during the phase of rapid expansion after 1830. Prior to that the Hillfoots woollen industry, like that of Scotland as a whole, was very largely water-powered.

- 1 : OSP 485:25 Haddington Town Council v. Haddington
Tarred Wool Company
- 2 : Martindale, J.G. "The Rise and Growth of the Tweed
Industry in Scotland" in Jenkins, J.G. (Ed) "The
Wool Textile Industry in Great Britain" London 1972 273
- 3 : SRO NG1/1/26 27/6/87, 27/6/87
- 4 : SRO NG1/1/27 10/2/90: 8/12/90
- 5 : Findlater, C. "General View of the Agriculture of
Peeblesshire" Edinburgh, 1802 218
OSA XIX 598 Innerleithen, Peeblesshire
Buchan, J.W. "A History of Peeblesshire" 3 vols.,
Glasgow 1925 II 217
- 6 : SRO NG1/1/27 2/2/91
- 7 : Galashiels: SRO NG1/1/28 29/2/92, 15/1/94
Tullibody: SRO NG1/1/28 10/12/94
Braelangwell, Ross-shire: SRO NG1/1/29 8/2/97
Greenlaw, Berwickshire: SRO NG1/1/29 26/6/99
OSA VI 34 Newhills, Aberdeenshire
OSA XV 287 Longside, Aberdeenshire
OSA XV 80 Twynholm & Kirkchrist, Kirkcudbrightshire
- 8 : Duntocher, established in 1785, was reputedly one of
the first mechanised woollen mills in Scotland:
Devine, T.M. "Glasgow Merchants and Colonial Trade
1770-1815" Strathclyde University PhD 1972 II 378
OSA V 229 Old Kilpatrick, Dunbartonshire
- 9 : Richards, R.T.D. "The Development of the Modern Woollen
Carding Machine" in Jenkins op.cit., 73-4
- 10 : Mann, J. de L. in Singer, C., Holmyard, E.J., Hall,
A.R. & Williams, T.I. (Eds) "A History of Technology"

cont'd

- 5 vols. Oxford, 1956-9 IV 298
- 11 : Richards, op.cit., 74
 - 12 : Hall, R. "The History of Galashiels" Galashiels 1898 422
SRO NG1/1/25 23/1/86: three scribbling machines
erected by Mercer
 - 13 : Hall, op.cit., 422-3
 - 14 : Ibid., 424
 - 15 : SRO NG1/1/27 2/2/91
 - 16 : SRO NG1/1/28 10/12/91, 28/5/94
SRO NG1/1/30 11/12/99
 - 17 : SRO NG1/1/28 15/1/94
SRO NG1/1/29 23/5/98
SRO NG1/1/29 26/6/99, 13/2/99, 8/6/96, 8/2/97
SRO NG1/1/30 20/11/99
 - 18 : Morgan, P. "Annals of Woodside & Newhills" Aberdeen 1886 191
 - 19 : Findlater, op.cit., 218
 - 20 : Hall, op.cit., 301
SRO NG1/1/28 25/1/92
 - 21 : SRO NG1/1/29 29/6/96
 - 22 : SRO NG1/1/32 8/7/07
 - 23 : For further information on carding machinery see
Richards, R.T.D., op.cit. 71-84
 - 24 : Richards, op.cit., 79
 - 25 : McKechnie, K. "A Border Woollen Town in the Industrial
Revolution" London 1974 53
 - 26 : Gulvin, C. "The Tweedmakers" Newton Abbot, 1973 101
 - 27 : SRO NG1/1/34 10/7/22
 - 28 : SRO NG1/1/30 27/11/99
SRO NG1/1/29 29/11/97
 - 29 : See Chapter 20

- 30 : Loch, D. "A Tour through most of the Trading Towns
and Villages of Scotland" Edinburgh 1778 1
- 31 : SRO NG1/1/33 21/2/16
- 32 : Mann, op.cit., 299
- 33 : Hall, op.cit., 394
- 34 : Ibid., 429
- 35 : SRO NG1/60/54/1
- 36 : Scots Magazine LI (1789) 618
- 37 : See Chapter 3 p 62
Chapter 18 p 379
- 38 : SRO NG1/1/27 23/6/90
- 39 : SRO NG1/1/28 29/2/92
Hall, op.cit., 426
- 40 : SRO NG1/1/32 16/12/07
- 41 : Mann, op.cit., 304
- 42 : Ibid., 304
- 43 : SRO NG1/1/32 26/6/11
- 44 : SRO NG1/1/33 29/1/12; 13/1/13; 7/2/16
- 45 : SRO NG1/1/33 19/6/16
- 46 : Mann, op.cit., 305
- 47 : SRO NG1/1/34 23/5/20
- 48 : SRO NG1/1/35 7/7/1829
- 49 : SRO NG1/1/34 10/7/22
SRO NG1/1/35 29/6/24
- 50 : SRO NG1/a/32 10/7/11
- 51 : See Chapter 29 p 759
- 52 : NSA III 405 Hawick, Roxburghshire
- 53 : PP 1843 LVI 359
- 54 : Wilson, R. "A Sketch of the History of Hawick" Hawick
1825 287-8

- 55 : SRO NG1/1/32 6/7/08
- 56 : SRO NG1/1/31 11/12/05
- 57 : SRO NG1/1/32 8/7/07
Robertson, J. "General View of the Agriculture of Inverness-shire" London 1808 314
SRO NG1/1/32 4/7/10
- 58 : OSA XIX 598 .Innerleithen, Peeblesshire
Findlater, op.cit., 218
- 59 : SRO NG1/1/29 8/6/96; 8/2/97; 14/2/98
SRO NG1/1/30 13/2/99
Hume, J.R. "The Industrial Archaeology of Scotland"
2 vols. London, 1976-7 II
- 60 : Donnachie, I. "Industrial Archaeology of Galloway"
Newton Abbot, 1971, 68, 75-7
- 61 : Ibid., 68
OSA XV 80 Twynholm & Kirkchrist, Kirkcud-
brightshire.
- 62 : Robertson, op.cit., 314
- 63 : SRO NG1/1/31 26/1/03
Farmers' Magazine V 8 (1804)
- 64 : Donnachie, op.cit., 74
Singer, W., "General View of the Agriculture of the County of Dumfries" Edinburgh 1812 62-3
- 65 : SRO NG1/1/30 9/5/1800
- 66 : SRO NG1/1/26 11/2/89
- 67 : SRO NG1/1/28 28/5/94
SRO NG1/1/29 25/1/97
- 68 : SRO NG1/1/29 25/1/97

- 69 : SRO NG1/1/29 7/2/98
SRO NG1/1/31 19/12/04
SRO NG1/1/33 30/6/13; 24/11/13
Hume, J.R. in Scottish Society for Industrial Archaeology Newsletter, No. 4, Pt. 1 May 1972
Hume, J.R. op.cit., (1976-7) I.75
- 70 : SRO NG1/1/23 2/7/83
Hall, op.cit., 395
- 71 : Ibid., 391, 395
- 72 : Ibid., 399-402
- 73 : Ibid., 387, 394, 404, 405
- 74 : Ibid., 382-407
- 75 : SRO NG1/1/30 3/7/99
OSA XXI 245-6 Langholm, Dumfriesshire (Addenda)
- 76 : SRO NG1/1/32 21/12/08
- 77 : Thomson, G. "The Dalnotter Iron Company" SHR XXXV
(1956) 19-20
Devine, op.cit., II 378
- 78 : OSA V 229 Old Kilpatrick, Dunbartonshire
- 79 : Morgan, op.cit., 190-1
- 80 : Gulvin, op.cit., 58
- 81 : OSA X 635 Spynie, Moray
Gulvin, op.cit., 58
- 82 : SRO NG1/1/30 17/12/1800
SRO NG1/1/32 8/7/07
- 83 : Leslie, W. "General View of the Agriculture of the Counties of Moray & Nairn" London 1811 400-1
- 84 : NSA VIII 25-6 Old Kilpatrick, Dunbartonshire
Donnachie, op.cit., 95-6

- 85 : Naismith, J. "Thoughts on the Various Objects of Industry pursued in Scotland" Edinburgh 1790 479
- 86 : SRO NG1/1/30 5/6/99
SRO NG1/1/32 3/2/08
SRO NG1/1/34 15/6/19
- 87 : SRO NG1/1/29 13/2/99
- 88 : NSA VIII 70 Killearn, Stirlingshire
- 89 : SRO NG1/1/31 6/7/03
PP 1834 XIX Factory Commission 163-4
- 90 : SRO NG1/1/29 7/3/98
- 91 : SRO NG1/1/31 11/12/05
- 92 : SRO NG1/1/31 30/6/02
Findlater, op.cit., 218
- 93 : SRO NG1/1/32 10/7/11
- 94 : SRO NG1/1/35 17/6/1828
Dick-Lauder, Sir T. "An Account of the Great Floods of August 1829, in the Province of Moray and Adjoining Districts" Edinburgh, 1830 73
- 95 : SRO NG1/1/33 5/7/15
- 96 : SRO NG1/1/23 2/7/83
- 97 : SRO NG1/1/26 23/7/88; 6/8/88
- 98 : Wilderhaugh : SRO NG1/1/23 22/1/83
Buckholmside: SRO NG1/1/26 23/7/88
Dryburgh: Scots Magazine LI (1789) 618
Innerleithen: OSA XIX 598
Cluny (Perthshire) : SRO NG1/1/29 29/6/96
Tillicoultry: Gibson, W. "Reminiscences of Dollar, Tillicoultry and other Districts adjoining the Ochils"
Edinburgh 1883 171
- Alloa: SRO NG1/1/28 10/12/94

continued over:

- 98 : Moffat: SRO NG1/1/29 2/3/96
- 99 : Langholm: SRO NG1/1/30 3/7/99
- 100 : Berryscar: SRO NG1/1/30 5/6/99
- 101 : Kirkinner: SRO NG1/1/29 28/6/97
- 99 : Hall, op.cit., 382-407
- 100 : SRO NG1/1/29 14/6/97; 28/6/97
- 101 : Innerleithen, Findlater, op.cit., 218
- Galashiels: SRO NG1/1/28 15/1/94
- Duntocher: Devine, op.cit., 378
- Stoneywood: Morgan op.cit., 190
- 102 : Morgan, op.cit., 191 A carding mill, built at Old Mill of Strichen, c.1797, was founded by Matthew Young, who had been brought to Stoneywood to install machinery.
- 103 : Donnachie, op.cit., 68
- OSA XV 80 Twynholm & Kirkchrist, Kirkcudbrightshire
- 104 : Newmill: SRO NG1/1/30 17/12/1800
- Tammore, Banffs: SRO NG1/1/31 6/7/03
- Peebles: SRO NG1/1/31 3/2/1802
- Romano Bridge: SRO NG1/1/32 5/7/09
- 105 : NSA V 233 Dalry, Ayrshire
- 106 : Edenbank, SRO NG1/1/34 4/7/20
- 107 : SRO NG1/1/34 10/7/21
- 108 : PP 1839 XLII Factory Returns
- 109 : Hall, op.cit.
- 110 : Bremner, D. "The Industries of Scotland" (1869)
- Newton Abbot, 1969 208
- OSA XV 164 Dollar, Clackmannanshire
- 111 : SRO NG1/1/28 30/11/91
- 112 : SRO NG1/1/28 10/12/94
- 113 : Gibson, op.cit., 13

- 114 : Ibid., 171
- 115 : SRO NG1/1/31 8/7/01
- 116 : SRO NG1/1/31 13/6/04
- 117 : Gibson, op.cit., 177
- 118 : Ibid., 177-8
- 119 : PP 1834 XIX Factory Commission 30
- 120 : SRO NG1/1/33 3/7/16
- SRO NG1/60/54/1 Survey of Woollen Machinery and Mills
- 121 : SRO NG1/60/54/1
- 122 : PP 1834 XIX 30-31
- 123 : SRO NG1/60/54/1
- PP 1834 XIX 30-31
- 124 : NSA VIII 230 Logie, Stirlingshire
- 125 : SRO NG1/1/33 5/7/15
- 126 : SRO NG1/60/54/1
- 127 : Ibid.
- 128 : SRO NG1/1/34 29/6/19
- 129 : Gibson, op.cit., 193
- 130 : Ibid., 193
- 131 : In 1834 Alloa had six woollen mills, four of which
were steam-powered:
- NSA VIII 48 Alloa, Clackmannanshire
- Both Old and New Mills were still functioning in the
1860's: Bremner, op.cit., 207-8
- 132 : PP 1834 XIX 28-9
- 133 : Ibid.
- SRO NG1/60/54/1
- 134 : PP 1834 XIX 29-30
- 135 : SRO NG1/1/33 3/7/16
- 136 : SRO NG1/60/54/1

- 137 : PP 1834 XIX 30
- 138 : Similar hard luck stories came from manufacturers on
the Ericht in Perthshire and the Don in Aberdeenshire.
- 139 : OSA II 164 Dollar, Clackmannanshire
- 140 : Gibson, op.cit., 13
- 141 : SRO NG1/1/32 9/7/06
- 142 : PP 1834 XIX 218-9
- 143 : Gibson, op.cit., 13
- 144 : SRO NG1/1/34 10/7/21
- 145 : NSA VIII 110 Dollar, Clackmannanshire
- 146 : Bremner, op.cit., 208
- 147 : Ibid., 208
- Gibson, op.cit., 171
- 148 : SRO NG1/1/31 8/7/1801
- 149 : Gibson, op.cit., 171-2
- SRO NG1/1/32 8/7/07
- 150 : SRO NG1/1/33 5/7/15
- 151 : Gibson, op.cit., 178
- 152 : Ibid., 179
- 153 : Ibid., 179-80
- 154 : Ibid., 181
- 155 : Ibid., 172, 181 The term "Horse Mill" referred to an
earlier horse-driven carding mill.
- 156 : SRO NG1/1/34 10/7/22
- SRO NG1/1/35 7/7/29
- 157 : SRO NG1/60/52/16
- 158 : Gibson, op.cit., 181
- PP 1834 XIX 33-4
- SRO NG1/1/34 10/7/22
- 159 : SRO NG1/1/34 10/7/22

- 160 : SRO NG1/1/35 10/7/1827
- 161 : PP 1834 XIX 33-4
- 162 : Ibid., 33-4
- 163 : Ibid., 33
Gibson, op.cit., 175
- 164 : SRO NG1/1/34 30/6/18
- 165 : SRO NG1/60/54/1
PP 1834 XIX 31-3
- 166 : Bremner, op.cit., 209
Gibson, op.cit., 181
- 167 : Gibson, op.cit., 181
- 168 : SRO NG1/60/54/1
- 169 : PP 1834 XIX 31-3
- 170 : SRO NG1/1/34 4/7/1829
- 171 : Gibson, op.cit., 180
SRO NG1/1/35 28/6/1825
SRO NG1/60/52/14
- 172 : SRO NG1/60/52/14
- 173 : PP 1834 XIX 35-6
- 174 : Gibson, op.cit., 181
SRO NG1/1/36 5/7/31
- 175 : PP 1834 XIX 34-5
SRO NG1/1/36 5/7/31
- 176 : NSA VIII 73 Tillicoultry, Clackmannanshire
- 177 : Bremner, op.cit., 210
- 178 : SRO NG1/60/54/1
- 179 : SRO NG1/1/34 10/7/22
- 180 : PP 1834 XIX 218-9
- 181 : SRO NG1/60/52/16
- 182 : SRO NG1/1/32 6/7/08

182: Cont'd

SRO NG1/1/33 1/1/17

PP 1834 XIX 221

183: SRO NG1/60/54/1

184: PP 1834 XIX 221

185: SRO NG1/1/34 10/7/21

186: PP 1834 XIX 222

187: Gibson, op.cit., 193

188: Ibid., 193

189: NSA VIII 188 Alva, Stirlingshire (Clackmannanshire)

190: PP 1839 XLII 315

191: Ibid., 315